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Ordnance Pamphlet 1139

FLAME THROWERS

Description and Instructions for Operation



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14 June 1944

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NAVY DEPARTMENT
BUREAU OF ORDNANCE
WASHINGTON, D. C.

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14 June 1944

ORDNANCE PAMPHLET 1139

FLAME THROWERS, DESCRIPTION AND INSTRUCTIONS FOR OPERATION

1. Ordnance Pamphlet 1139 is designed to furnish descriptions and instructions for operation of all large flame throwers and all appurtenant equipment in use by the Navy.

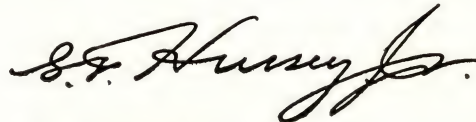
2. This publication should be used as a guide in the operation, fueling, installation, and maintenance of all large flame throwers available to Naval personnel.

3. OP 1139 (Preliminary) is hereby superseded and should be destroyed by burning.

4. The following publications contain additional information concerning large flame throwers:

- (a) Ronson F.U.L. Unit Mark IV (Canadian)
Instruction Book and Parts List
- (b) War Department Technical Bulletin TB CW2
Mechanized Flame Throwers E5R1-5 and E4-5
- (c) Portable Flame Throwers E2
NDRC Report PDN - 2057 of 15 February 1944

5. This publication is CONFIDENTIAL and should be safeguarded and handled in accordance with the Registered Publication Manual and Article 76, U. S. Navy Regulations, 1920.



G. F. HUSSEY, JR.
Rear Admiral, U. S. Navy
Chief of the Bureau of Ordnance

CONTENTS

O P 1139

	Page
INTRODUCTION	7
FUEL UNIT	8
GUN UNIT	17
DISASSEMBLY AND ASSEMBLY	27
INSTALLATION	31
OPERATION	33
FUEL SERVICING	37
AIR SERVICING	43
TESTING AND MAINTENANCE	44
FLAME THROWER MK 2 AND MOD	51

CONFIDENTIAL



Frontispiece.—Flame Thrower Mk 1, Firing Thickened Fuel at Approximately Ten Degrees Elevation Downwind

INTRODUCTION

O P 1139

INTRODUCTION

1. **Flame throwers** are offensive weapons used to eject a stream of liquid fire at close range against enemy fortifications in order to destroy them. The fire is created by igniting gasoline thickened with Napalm which continues burning after the stream lands on the objective.

The flame throwers described in this pamphlet are of the fixed installation type available for Navy use. Designed to be mounted in landing craft, such as the LCVP, LCM, LCT, they may also be adapted to the LCT-3 installations used in beach operations or mounted on suitable trucks or half tracks.

The range of this type flame thrower is 25 to 200 yards, dependent on (a) thickness of fuel used (b) windage and (c) pressure of ejection.

2. Each flame thrower consists of two interconnected units; a fuel unit and a gun unit. The fuel unit serves as a storage for the fuel and, when provided with sufficient pressure, furnishes fuel to the gun unit, from which it is expelled and ignited to the target desired.

The gun is capable of being elevated within limits of approximately $+45^{\circ}$ and -15° and of being trained to approximately 180° .

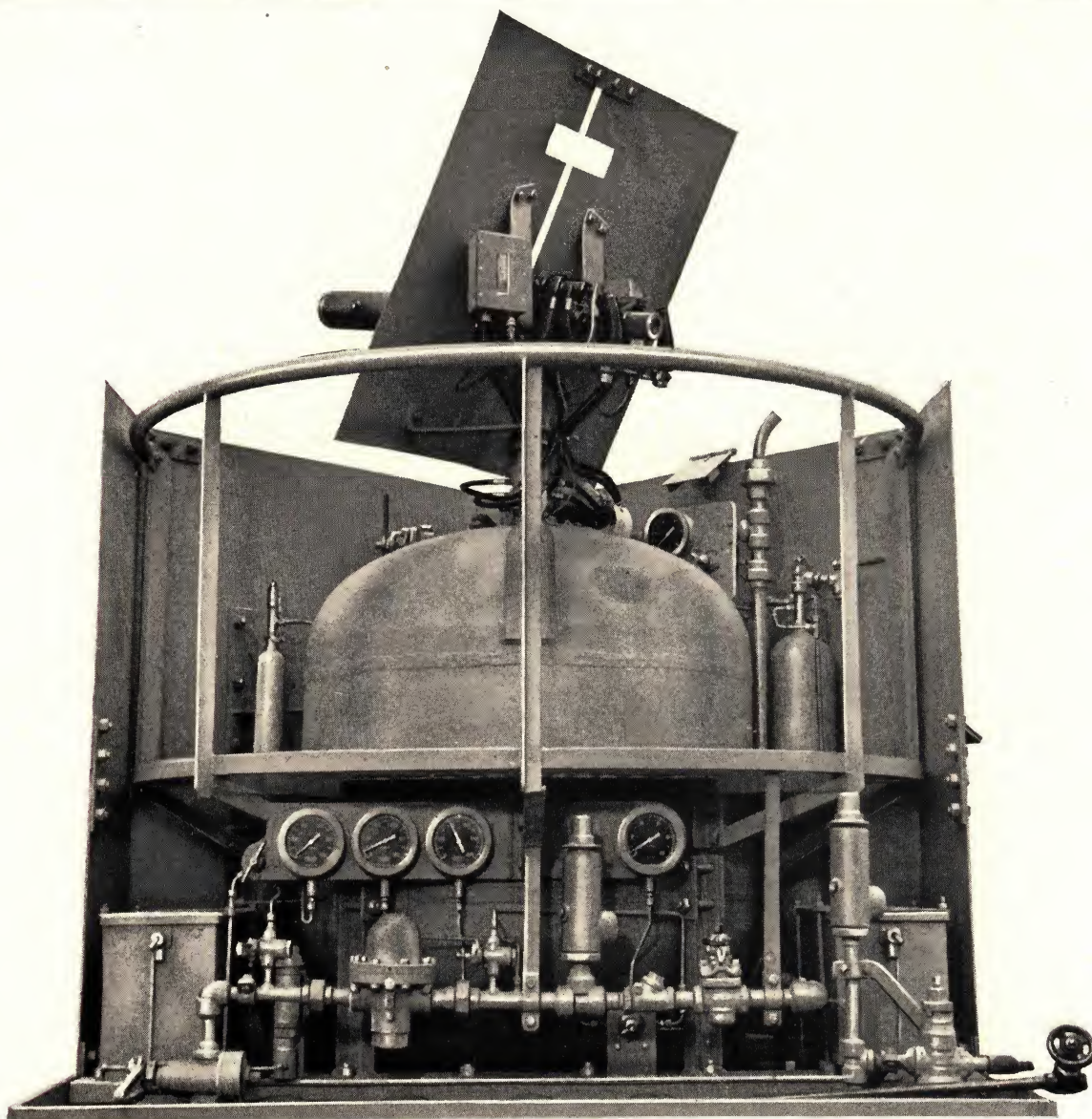


Figure 1.—Flame Thrower Mk 1—Rear View

FUEL UNIT

DESCRIPTION

3. Each fuel unit is composed of four main parts which include the **fuel tanks**, the **air supply system**, the **primary electric system**, and the **protective armor**.

(a) The fuel tanks include: the main fuel (gel) tank, which has a total capacity of 220 U. S. gallons and a fuel capacity of 200 U. S. gallons to allow for an air space at the top, the lubricating fuel

FUEL UNIT

O P 1139

tank, which has a capacity of three U. S. gallons; and an atomizer gasoline tank, having a capacity of one half U. S. gallon.

(b) The air supply system includes an air reservoir which consists of seven I. C. C. 3A-1800 shatter-proof air bottles having a total volumetric capacity of approximately 10.5 cubic feet. Also an air transfer system which consists of pipes, tubes, valves, gauges, and air pressure regulators which allow the passage of air at the proper pressure to the various parts of the unit where it acts as the motivating force.

(c) The primary electrical system consists of two six-volt 100-ampere-hour storage batteries enclosed in battery boxes. These are connected in series with the necessary leads to conduct this primary

current to the ignition system. The ignition system is described as part of the gun unit.

(d) The protective armor includes the fuel tank protective armor, which consists of $\frac{1}{4}$ -inch homogeneous steel armor plate in a V around the fuel tanks, and additional $\frac{1}{4}$ -inch homogeneous steel plates extending parallel to the sides of the air bottles one and one half feet aft of the end of the V, for side protection of the tanks. The air bottle protective armor has $\frac{1}{2}$ -inch homogeneous armor plate around the front and sides of the air bottles. There is an additional $\frac{1}{2}$ -inch steel plate at the rear of the air bottles, but this is not armor plate and is placed there to protect the air bottle assembly during movement of the unit.

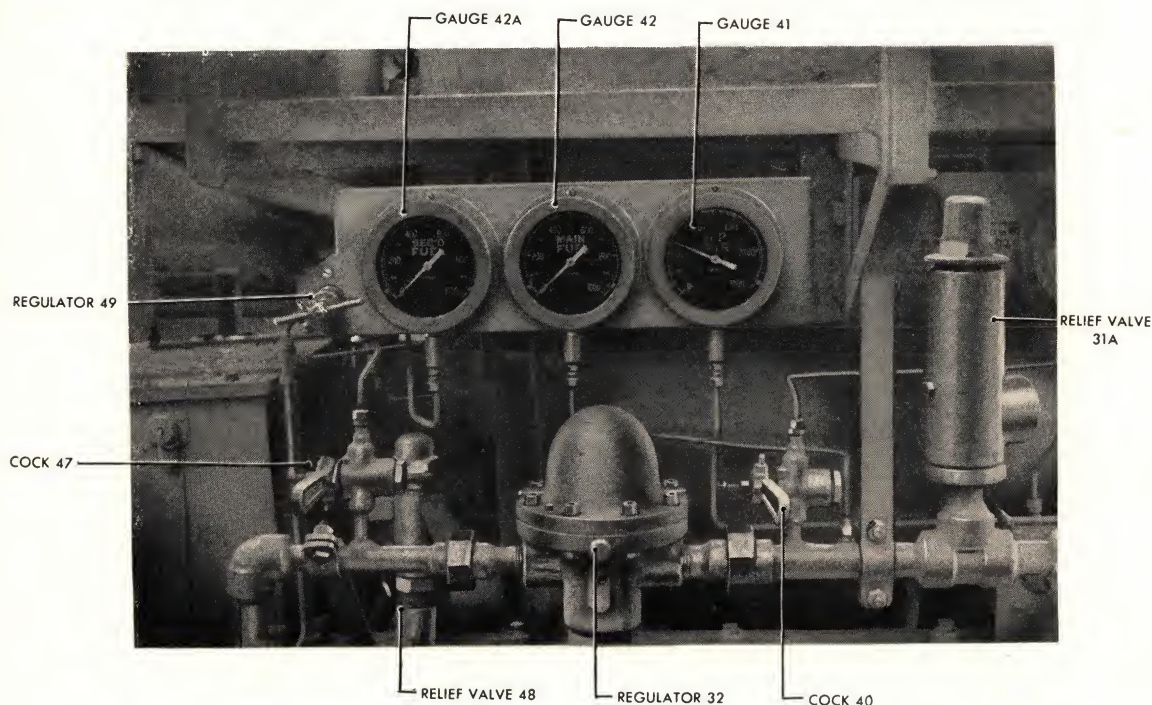


Figure 2.—Flame Thrower Mk 1—Fuel Unit—Main Air Line From Air Bottles to Gel Tank.

AIR SYSTEM

4. The **air system** consists of the **air inlet line**, the **air bottle assembly**, the **air transfer system**, the **lubricating fuel air line**, the **atomizer gasoline air line** and the **atomizer air line**.

(a) The air inlet line, (See Figs. 1 and 2), consists of a $\frac{3}{4}$ -inch high-pressure seamless steel pipe with standard pipe threads. The end of the pipe is fitted with an adapter to take the union on the end of the air charging hose. A cap is provided to protect the threads of this fitting. A filling valve No. 46 is a $\frac{3}{4}$ -inch cast steel socket end (Hypre Seal) cock. This cock is opened manually to allow air to flow into the air bottles as they are being charged. It is closed when charging has been completed. Overcharging is prevented by a relief valve, No. 30. This is a one-inch F.M. inlet, $1\frac{1}{2}$ inch F.M. outlet-type JMB-C valve. It is set to relieve at 2200 p. s. i. If an attempt is made to charge the air bottles higher than 2200 p. s. i., this valve opens and allows air to discharge into the atmosphere. The amount of pressure stored in the air bottles is shown on gauge No. 41, which is a pressure gauge, Style AH, and is graduated from 0 to 3000 p. s. i. This gauge is bottom-connected to the high-pressure air line from the air bottle manifold. It should be carefully checked during the air bottle charging period, so that the compressor may be cut off when a MAXIMUM of 2000 p. s. i. has been placed in the bottles.

(b) The air bottle assembly is the air storage reservoir. It consists of seven I. C. C. 3A-1800 shatter-proof air bottles, each having a capacity of approximately 1.5 cubic feet. These are the high-pressure air storage vessels. They are connected to a manifold of extra heavy seamless steel pipe with seven high-pressure pipe unions to the air bot-

ties. Charging of the air bottles through the manifold is accomplished by means of the air charging connection mentioned above. The high-pressure air bottles are held together and supported by pieces of channel steel, held together with bolts.

(c) The air transfer system (main air line) supplies air from the air reservoir to the entire unit. It connects the air bottle manifold to the gel tank through cock No. 36, the main air line cock, which, when opened, allows the flow of air from the air bottles to the remainder of the fuel unit. Should a serious leak occur in the gel tank, in the gun, or in any portion of the equipment on the fuel unit side of cock No. 36, it should be immediately closed. This cock is of the same type as cock No. 46. From cock No. 36 the high pressure air is led through pressure regulator No. 32, which is a Grove GBX306-4, inlet 510-2000 p. s. i., outlet 0-500 p. s. i. regulator. This dome regulator reduces the air pressure from the bottles to the operating pressure of 450 pounds. The pipe in this main air line is seamless steel pipe, and all connections (except those on regulators and relief valves) are brazed. The operating pressure at the outlet of regulator No. 32 is indicated on gauge No. 42, a pressure gauge, Style AH, graduated from 0 to 1000 p. s. i. This gauge indicates the pressure on the main air line, which leads to the top of the main fuel tank. In service the reading on this gauge should be taken frequently as a check on regulator No. 32. A relief valve No. 31A is identical with relief valve No. 30, except that it is set to relieve at 550 p. s. i. (see Figs. 1 and 2), so that the main air line is not subjected to more pressure than it will safely stand. A one-inch horizontal bronze check valve, No. 35, prevents any material from flowing back through the line to the pressure regulators and gauges.

FUEL UNIT

O P 1139

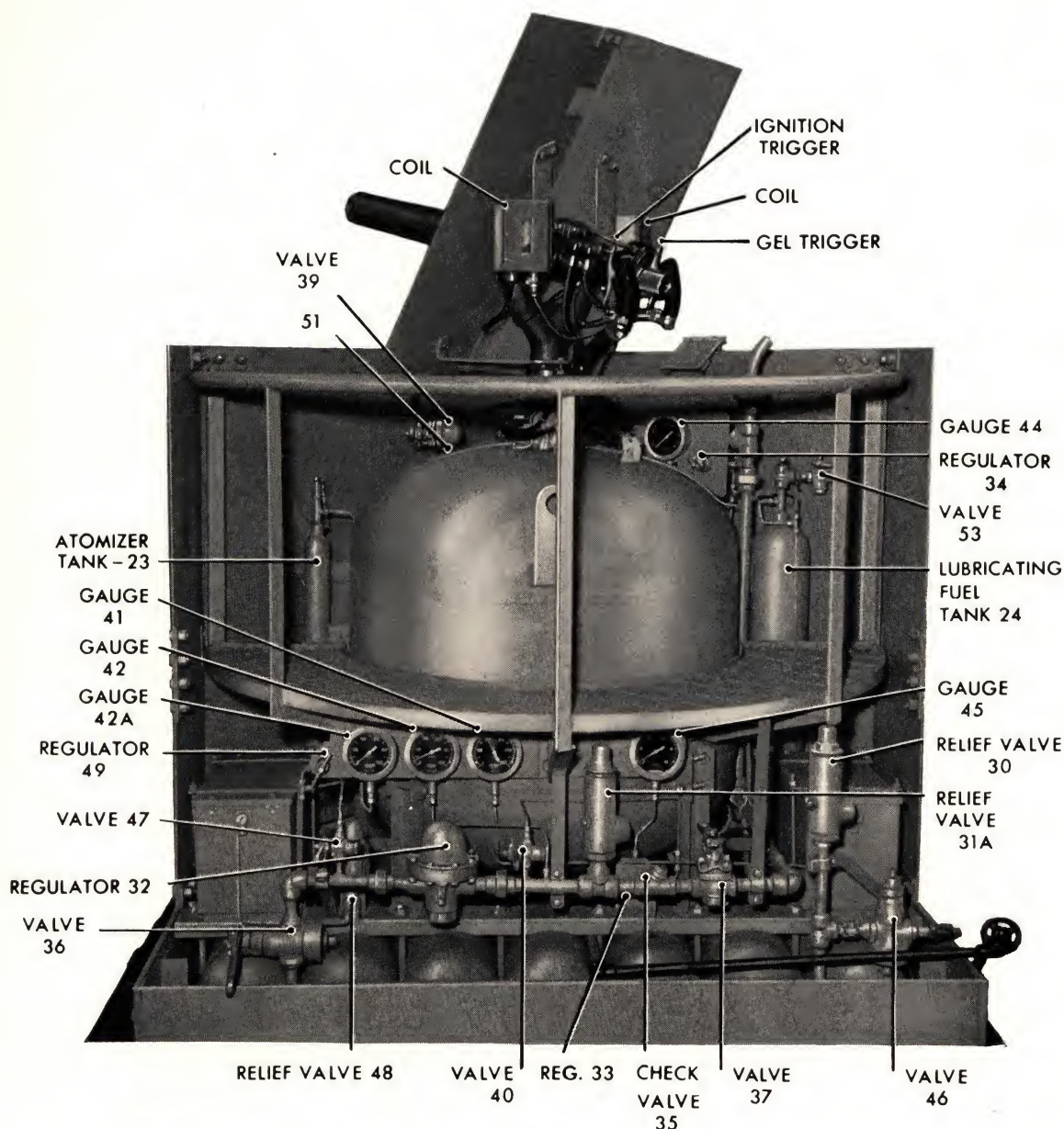


Figure 3. Complete Rear View of Mounted Flame Thrower Mk 1

Cock No. 37 is a one-inch cast steel cock. (See Fig. 3.) It acts as a shut-off between the main air line and the gel tank. A third relief of excess pressure to the main fuel tank is a safety head, No. 31. This is a one inch (Union Type) threaded base and threaded hold down, 750 p. s. i. rupture pressure safety head.

(d) The lubricating fuel air line supplies pressure at 550 p. s. i. to force gasoline from tank No. 24 to the gun when it is being fired. A $\frac{1}{4}$ -inch steel pipe approximately three inches long brings air from the main air line on the high-pressure side of regulator No. 32.

CONFIDENTIAL

Attached to this pipe is a $\frac{1}{4}$ -inch cock, No. 47. This admits high-pressure air into the lubricating fuel air line. From cock No. 47 the air goes to pressure regulator No. 49, where it is reduced to 550 p. s. i., and then to the top of the lubricating fuel tank. This air line is $\frac{1}{4}$ -inch O. D. high pressure tubing. Pressure regulator No. 49 is a $\frac{1}{4}$ -inch screw type regulator, No. 511; inlet 2000 p. s. i. outlet 0-800 p. s. i. It is normally set to the operating pressure of 500-550 p. s. i., as shown on gauge No. 42A, similar to No. 42. On the same line, is a relief valve, No. 48, set at 650 p. s. i. Extending from the top of the lubricating fuel tank No. 24 is a short length of pipe, and joined to it is the $\frac{1}{4}$ -inch O. D. lubricating fuel air line leading from regulator No. 49.

Just above the point at which the air line joins the pipe extending from the top of tank No. 24, is a tee with bleeder valve No. 53, attached to the horizontal arm. On the vertical extension of the tee through which the tank is loaded, there is a removable filling plug. Bleeder valve No. 53 is a $\frac{1}{2}$ -inch cock and is used to bleed off pressure from the lubricating fuel tank before removing the plug for loading.

(e) The atomizer gasoline air line consists of a $\frac{1}{4}$ -inch high-pressure tube which comes off the main air line on the low-pressure side of regulator No. 32 through cock No. 40, a $\frac{1}{4}$ -inch cock, which permits the flow of 450 p. s. i. air through $\frac{1}{4}$ -inch O. D. tubing to regulator No. 33, and on to the atomizer gasoline tank No. 23 and gauge No. 45. Regulator No. 33 is of the screw type and has an inlet at 500 p. s. i. and an outlet of 0-25 p. s. i. It should be set to deliver air at four p. s. i., which is shown on gauge No. 45, graduated from 0-100 p. s. i. A $\frac{1}{4}$ -inch O. D. tube leads from the low-pressure side of the regulator to atomizer gasoline tank No. 23 and is connected at right angles to the tube extending from

the top of the tank, which has at its end a removable plug to permit filling this tank.

(f) The atomizer air line consists of a branch line of $\frac{1}{4}$ -inch O. D. high-pressure tubing which leads from the high-pressure side of regulator No. 33 up to regulator No. 34. This controls the pressure of the air supplied to the atomizer of the gun. This regulator is set to deliver air at 65 p. s. i. A $\frac{1}{4}$ -inch O. D. tubing and flexible hose connects the outlet of regulator No. 34 to the atomizer air valve of the gun. Pressure gauge No. 44 is connected to the $\frac{1}{4}$ -inch O. D. line on the low pressure side of regulator No. 34.

Joining the lubricating fuel tank No. 24 air line and the line to regulator No. 34 is a $\frac{1}{4}$ -inch O. D. steel tube containing a $\frac{1}{4}$ -inch check valve No. 475HTB-4S. The purpose of this valve is to prevent the pressure on the lubricating fuel from being lower than that on the gel, to keep the gel from backing up into the lubricating fuel system.

A branch line of $\frac{1}{4}$ -inch O. D. high-pressure tubing leads from the inlet line of regulator No. 34 and is connected to the main control valve and pilot valve of the gun unit by means of $\frac{3}{16}$ -inch I. D. flexible synthetic rubber hose. Thus, 450 p. s. i. air is furnished to the gun for the operation of valves.

MAIN FUEL TANK (Gel Tank)

5. The main fuel or gel tank is constructed of $\frac{3}{4}$ -inch boiler plate and has a volumetric capacity of 220 gallons. It is loaded with a maximum of 200 gallons of fuel, however, and is provided with a liquid level well, No. 51, and vent, No. 39, located about 15 inches from the center of the tank and extending about six inches below the top to prevent excess fuel being placed in the tank. During filling, it is essential that vent No. 39 ($\frac{1}{2}$ -inch 300 p. s. i. cast steel screwed end valve, Figs. 3 and 4), which is attached to the liquid level well on the tank, be open. It is also advisable to

FUEL UNIT

O P 1139

attach a pipe or hose to the upper end of vent No. 39 and allow it to hang over the side of the armor plate in such a manner as to eliminate any overflow of fuel inside the equipment.

Welded at the top to a connection and running down through the center of the gel tank is a three-inch pipe, having a flange 15 inches in diameter welded on it at the bottom. The edge of this flange is one inch above the bottom of the tank. When the gun is in operation, this flange acts as a baffle plate to prevent channeling of the air through the fuel. This insures smooth flow of fuel up the three-inch pipe to the gun.

Above the top of the gel tank, the three-inch pipe is connected to a short piece of three-inch pipe, called a spud or yoke connector, which in turn is connected to the yoke piece of the gun about ten inches above the top of the tank. Extra fuel units for series operation are provided with caps, and with sealing plugs sealed with a linear ring and held with split collars and Allen head screws.

The main air line inlet connection is 180 degrees removed from the liquid level well No. 51. Fifteen inches from the center of the top of the tank, there is a one-inch connection to which the main air line is attached. This allows air at 450 p. s. i. to enter the tank. A series connection, 15 inches directly forward of the spud piece at the top of the tank, is a three-inch flanged connection welded into the tank head. A blind cover is bolted to this connection during single unit operation. When it is desired to connect two units in series, this blind cover is removed and piping is connected to the flange.

On the fore and aft center line of the main fuel tank and welded to the vertical portion of the tank are two unit lifting lugs, which are used for connecting hoisting lines to the unit. Five inches from the center of the bottom of the main fuel tank is a one-inch tank drain connection. This is a one-inch pipe and extends aft by means of an elbow between air bottles five and six. At the end of this drain pipe is a plug which may be removed for draining.

LUBRICATING FUEL SYSTEM

6. Lubricating fuel tank No. 24 is a three-gallon capacity red brass (Anaconda 85) tank. At the top, it is fitted with a 1½-inch O. D. brass boss which is tapped for ½-inch pipe. Into this connector is screwed the pipe at the upper end of which is the filling plug.

Welded in the bottom of tank No. 24 is a one-and-one-half-inch O. D. boss which extends up inside the tank after tapering to one-inch O. D. for approximately three inches. The function of this inner tube is to prevent the lubricating fuel from carrying dirt, water, or other foreign matter which may settle to the bottom of the tank.

The lubricating fuel line, joined to the boss on the lower end of tank No. 24, is a ¼-inch tube which delivers the lubricating fuel to the terminal block attached to the spud piece extending from the gel tank. A ⅜-inch I. D. flexible hose carries the lubricating fuel from this point to the control valve of the gun.

ATOMIZER GASOLINE SYSTEM

7. The atomizer gasoline tank, No. 23, is a ½-gallon capacity red brass (Anaconda 85) tank. At the top it is fitted with a 1½-inch O. D. boss tapped for ½-inch pipe. Into this connection is screwed the pipe at the upper end of which is the filling plug. At the bottom, tank No. 23 has welded in a 1½-inch O. D. boss which, after tapering to ⅜-inch, extends up into the tank approximately 1¼ inches. The extension inside the tank is set to act as a trap to prevent any foreign material entering the atomizer.

The atomizer gasoline line is joined to the boss on the under side of tank No. 23. It is a ¼-inch O.D. tube which carries the atomizer gasoline to the terminal block at the rear of the spud piece. From the terminal block, as in the case of the lubricating fuel, a ⅜-inch I.D. flexible fabric synthetic rubber hose carries the atomizer gasoline to the atomizer control valve of the gun. From this valve it is carried to the atomizer itself by ⅜-inch copper tubing.

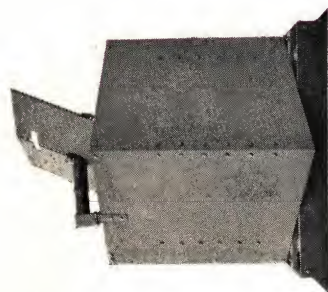


Figure 4A.—Flame Thrower Mk 1—Front View of Complete Unit with Gun Muzzle Held in Cover Plate for Protection of Chimney Interior

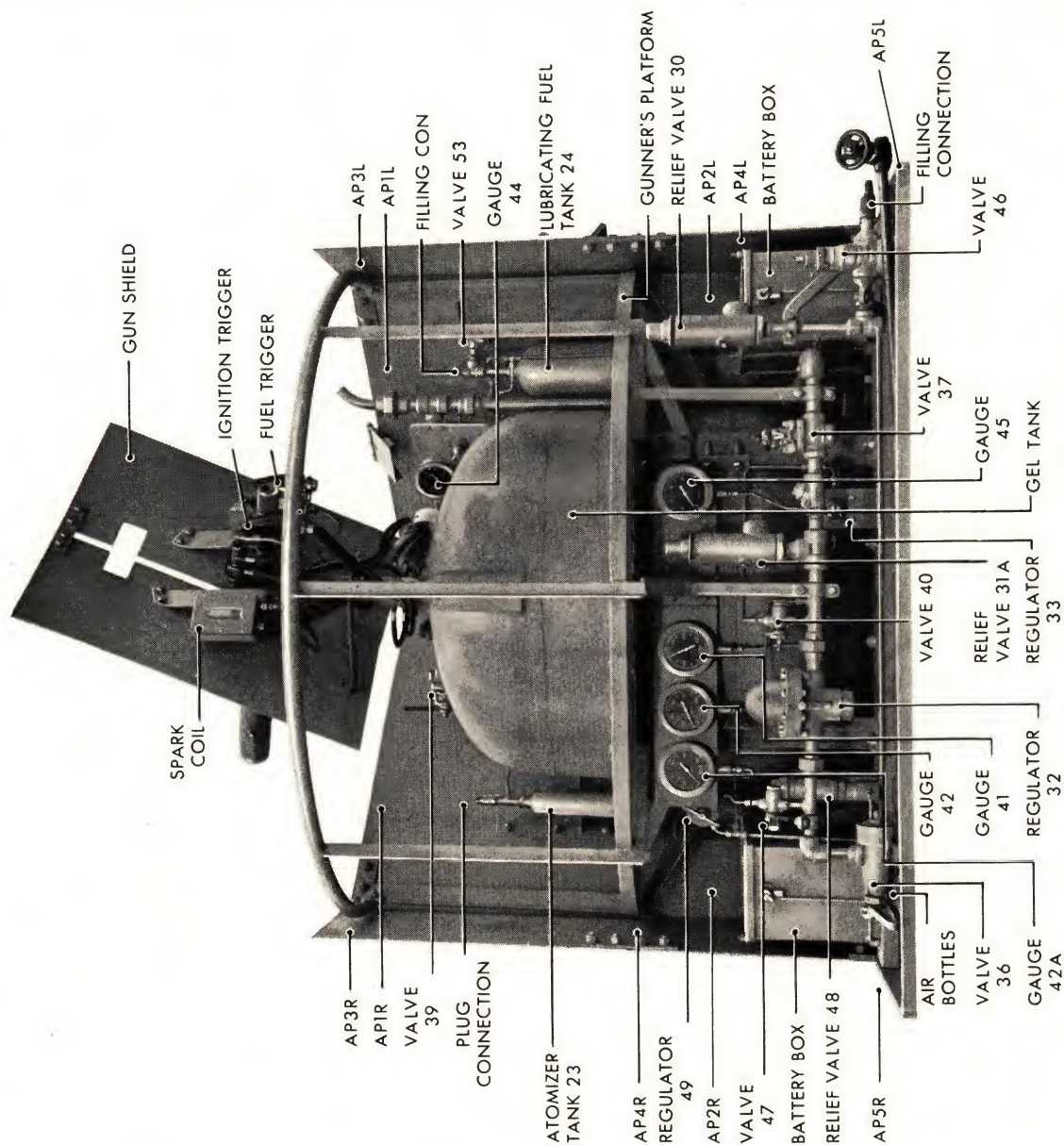


Figure 4.—Flame Thrower Mk 1—Rear View

FUEL UNIT

O P 1139

IGNITION SYSTEM

8. Each unit is supplied with two Battery Boxes Mark 14, and two six-volt batteries (6-V-3BM-100AH BuShips ad interim Spec. 17B4). The battery boxes, with one battery in each, are mounted on brackets aft the unit on each side. In the primary circuit, one terminal of the right-hand battery is grounded to the battery box. By means of a $\frac{1}{4}$ -inch tube this battery box is grounded to the frame of the assembly. The other terminal of this battery is connected to the opposite pole of the left hand battery, and the other pole of this battery is connected to one terminal of the switch in the left-hand trigger grip. The cables used for these connections are Navy Spec. SR1A-4 and are without splices. Passage through the battery boxes is through water-proof bushings, and the covers of the boxes are sealed with gaskets and held by bolts. Each box is provided with a weather-proof vent. Mounted one on the rear of either side of the gun shield armor plate are two spark coil and vibrator assemblies, No. 7, Electronics Laboratory Model S-1377-B, which step up the 12 volts received from the storage batteries to 12,000 volts.

One 7mm high tension lead, (Specification AN-J-C-56), from each spark coil assembly is connected to one of the two spark plugs inside the gun chimney. The high tension lead connections in the after compartment of the chimney are protected from excess heat by asbestos sleeves. The completion of the circuit is made by an electrode ground, located in the chimney and forming the spark gap for each of the spark plug electrodes.

PROTECTING ARMOR

9. The main fuel (gel) tank protecting armor consists of eight pieces of homogeneous steel OS-2380 armor plate bolted together in a "V" in front and 18-inch panels along the sides of the tank. (See Figs. 4 and 18.) The lower portion of the "V" is made up of two plates (AP-2-R and AP-2-L on Fig. 4) each $4'-5\frac{3}{4}'' \times 2'-0\frac{1}{2}'' \times \frac{1}{4}''$. The upper portion of the "V" is made up of two plates (AP-1-R and AP-1-L on Fig. 4) each $4'-5\frac{3}{4}'' \times 2'-9\frac{1}{2}'' \times \frac{1}{4}''$. These pieces are bolted together with

$6'' \times 2\frac{1}{2}''$ cleats to form a 90° angle. The assembly is located so that its apex is $3'-3''$ directly forward of the center of the gel tank. The side panels, connected by bolted cleats to the extremities of the "V", are made up of plates AP-3-R, AP-4-R and AP-3-L and AP-4-L respectively. Plates 3-R and 3-L are $1'-6'' \times 2'-9\frac{1}{2}'' \times \frac{1}{4}''$; and plates 4-R and 4-L are $1'-6'' \times 2'-0\frac{1}{2}'' \times \frac{1}{4}''$.

The air bottle protecting armor consists of three pieces of $\frac{1}{2}$ -inch homogeneous steel OS-2380 armor plate and one piece of $\frac{1}{2}$ -inch mild steel plate. These three pieces, AP6 ($6' 4'' \times 10\frac{1}{2}'' \times \frac{1}{2}''$), AP5L ($4' 10\frac{1}{2}'' \times \frac{1}{2}''$) and AP5R and the mild steel are bolted together to form a rectangle around the air bottles (See Figs. 4 and 4A). The mild steel protects the steel tubing at the neck of the bottles from blows they may suffer while the unit is being loaded or unloaded. This piece on the after end of the unit is not armor plate (see Fig. 2).

Gunner protecting armor consists of two pieces of $\frac{1}{2}$ -inch homogeneous steel OS-2380 armor plate. These two pieces of $\frac{1}{2}$ -inch plate (AP-7-R and AP-7-L on Fig. 4) are each $3' 4\frac{1}{2}'' \times 1' 6'' \times \frac{1}{2}''$. On the inside edge, each piece has a horizontal vision slot $3'' \times 4''$ cut in it $6\frac{1}{2}$ inches from the top. $10\frac{1}{4}$ inches below the bottom of the slot, the inside edge of the armor plate is cut away approximately two inches. This cutout extends to the bottom of the plate. The two pieces are bolted together by cleats so that their inside edges are one inch apart. This slot gives vision in elevation, and the cut away portion at the base provides clearance for the gun. The armor is mounted onto the gun yoke by brackets and trains with the gun but does not elevate with it.

GUNNER'S PLATFORM

10. The gunner's platform consists of a $\frac{3}{4}'' \times \frac{1}{8}''$ Gary welded floor grating $1' 2\frac{3}{8}''$ wide, mounted to the rear and extending 180° around the gel tank, $3' 1''$ from the deck. This platform is supported by five steel angles. The $\frac{1}{4}$ -inch pipe railing is $2' 6''$ above the platform and is supported by five pieces of angle iron.

FLAME THROWERS

O P 1139

PERTINENT DATA

11. Weight of Unit

Approximate Weight of Fuel Unit Unloaded..... 5,000 lb.
Approximate Weight of Gun Assembly (Including Armor Plate, etc.)..... 400 lb.
Total Approximate Weight of Flame Thrower Mk 1 Loaded with 200 Gallons
thickened fuel (approximately 7% Napalm)..... 6,600 lb.
Pressure Information

Name of Part	Design Pressure Pounds	Maximum Hydrostatic Test Pressure Pounds	Maximum Air Test Pressure Pounds	Relief Valve Setting Pounds	Recommended Operating Pressure Pounds
Gel tank	500	755	550	550	450
Lubricating Fuel Tank.....	650	1, 000	850	650	500-550
Atomizer Gasoline Tank....	100	200	200	-----	3-6
Air Bottles (ICC-3A).....	1, 800	3, 000	2, 200	2, 200	2, 000
Gun Assembly.....	350	600	500		400-450

GUN UNIT

O P 1139

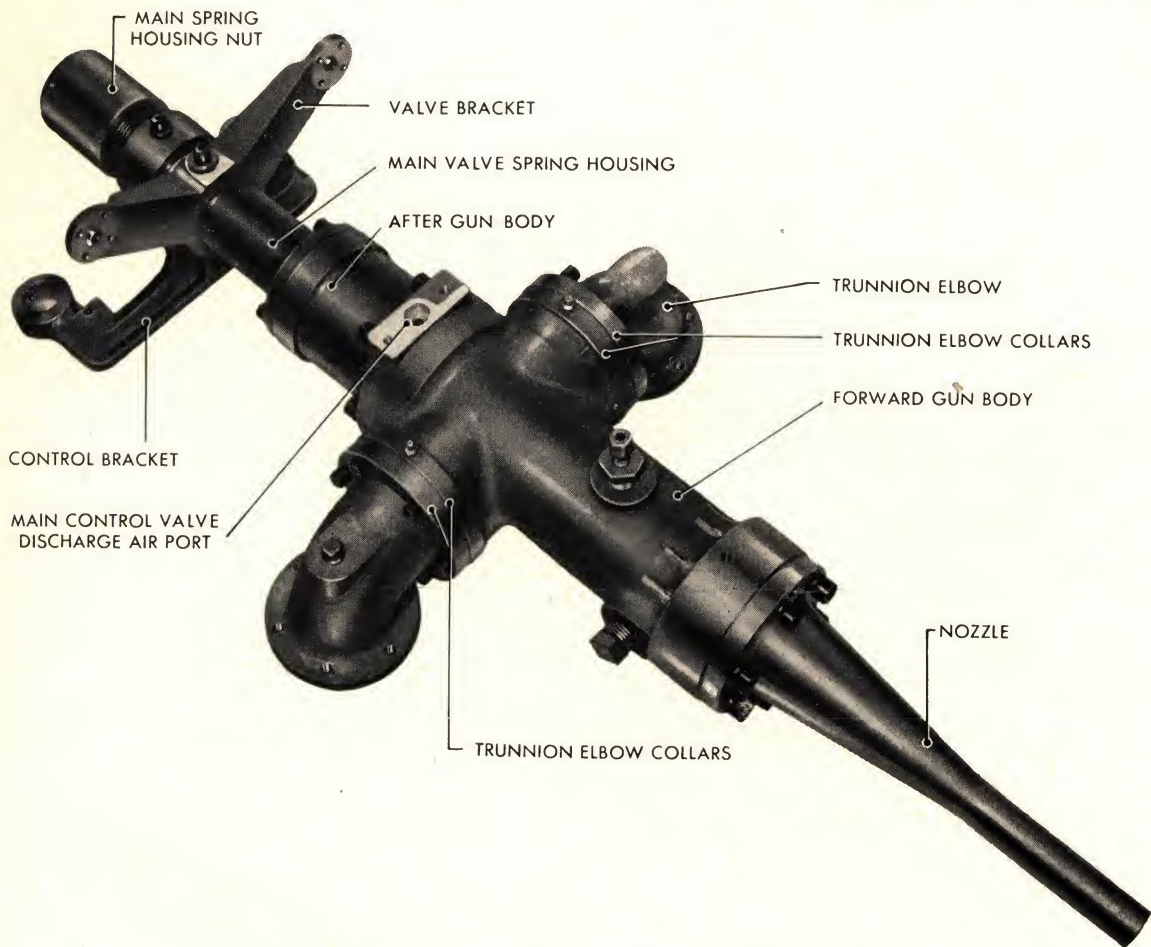


Figure 5.—Flame Thrower Mk 1—Gun with Subassemblies Removed

DESCRIPTION

12. The gun assembly consists of the gun, the yoke and yoke connector or spud piece, and all the parts mounted on the gun or forming an integral part of it. The gun consists of four main parts (See Figs. 5, 6, and 7), the nozzle, the forward gun body, the after gun body, and the main valve spring housing. The nozzle, a machined bronze casting tapering to ½-inch I. D. at the forward end, is bolted to the forward gun body, at its flange, by means of Allen head screws. The forward gun body, also a bronze casting, is machined on the inside and houses the main fuel valve. A flange on the bronze after gun body, which houses the air piston, connects it with Allen head screws to the forward gun body. The

main valve spring housing is of machined steel, and the flange at its forward end connects it to the after gun body with Allen head screws. A bronze cap is provided to hold the spring in the housing. The gun has the following supplemental assemblies:

- (a) The ignition chimney assembly (See Figs. 5 through 13.)
- (b) The main fuel valve
- (c) The trunnion elbows
- (d) The main control valve
- (e) The pilot valve
- (f) The atomizer control valve
- (g) The triggers and pistol grips
- (h) The trigger locks
- (i) The yoke and yoke connector

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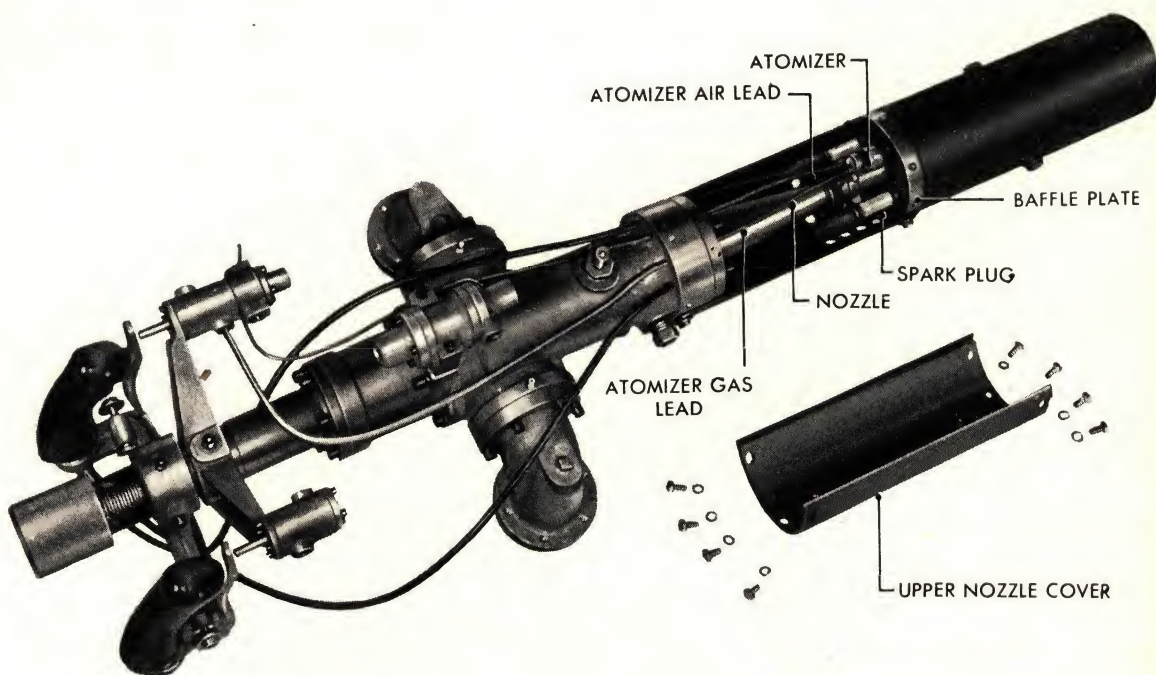


Figure 6.—Flame Thrower Mk 1—Gun With Upper Nozzle Cover Removed

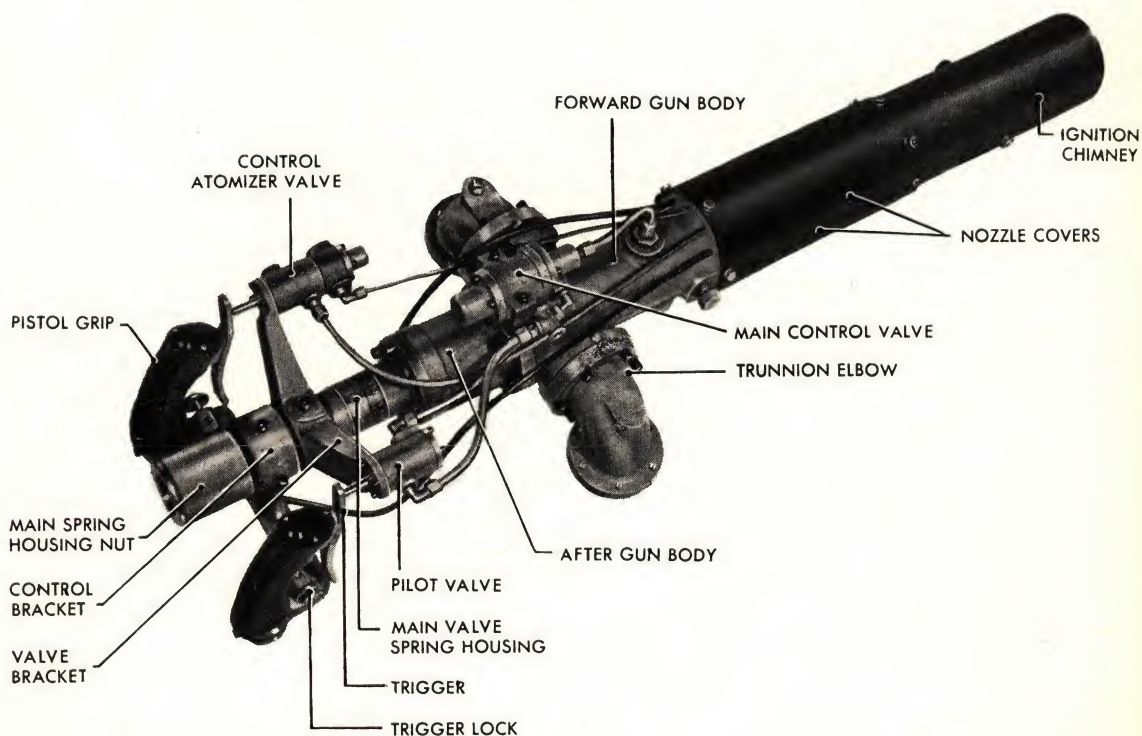


Figure 7.—Flame Thrower Mk 1—Gun With Subassemblies

GUN UNIT

O P 1139

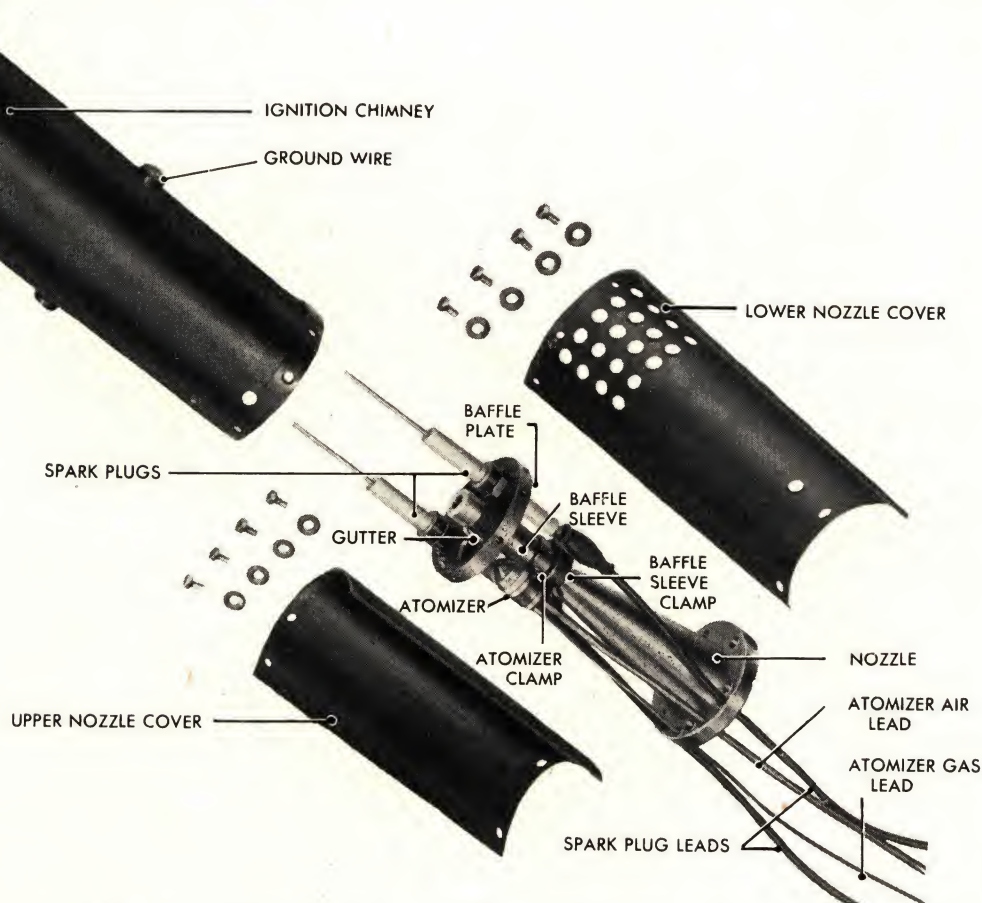


Figure 8.—Flame Thrower Mk 1—Gun Ignition Chimney Assembly

IGNITION CHIMNEY ASSEMBLY (See Figs. 5, 8, and 9.)

13. Two ignition chimneys are furnished: that supplied on the gun, a $\frac{1}{8}$ inch sheet steel chimney, and a $\frac{1}{2}$ inch sheet steel chimney which may be substituted for the former in the field if desired. Except for the difference in thickness, the two chimneys are almost identical. Beneath the nozzle cover is the atomizer mounted on a clamp on the nozzle approximately one inch behind the baffle plate, and directly behind the opening in the baffle plate. The atomized gasoline passes through this opening. A gutter is also provided to catch any drip from the atomizer nozzle. The gun nozzle protrudes through the baffle plate into the forward compartment of the chimney. The atomizer is supplied with gasoline at about

five p.s.i. and supplied with air for atomizing, and for aid in combustion, at 65 p.s.i. When current is provided, the sparks are set up between the two grounded electrodes in the chimney and their respective spark plugs. Thus, dual ignition is provided for the atomized gasoline and consequently the main fuel. Air holes are provided in the lower half of the nozzle cover, so that air may be drawn into the chimney and aid combustion.

MAIN FUEL VALVE (See Fig. 10.)

14. Within the forward part of the main gun body are three cylindrical lube blocks. These are held in place by a shoulder on the nozzle flange. When nozzle flange screws are tightened, a gap of about 0.005 inch is left between the nozzle shoulder and the forward lube block to permit sealing the nozzle flange

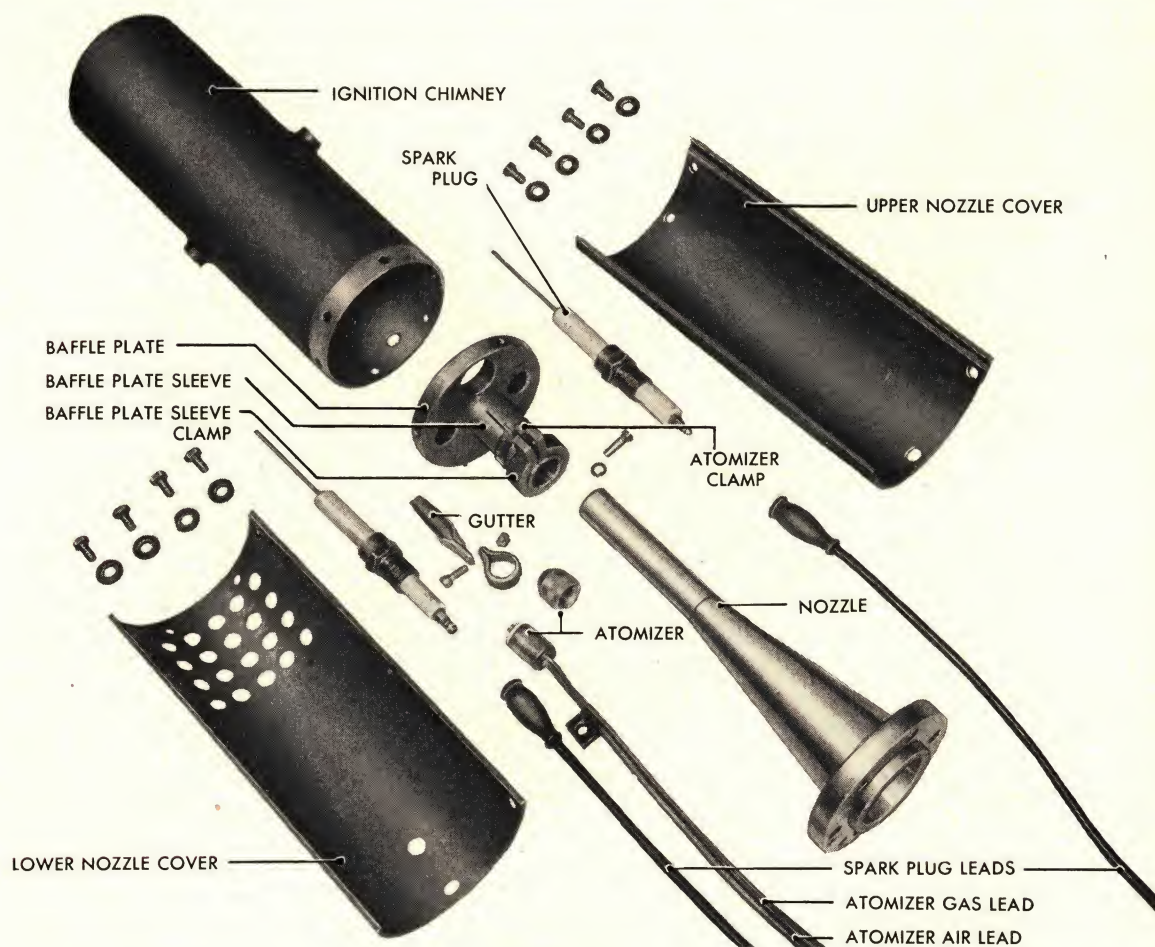


Figure 9.—Flame Thrower Mk 1—Gun Ignition Chimney Assembly—Completely Disassembled

joint and also to prevent crushing the lube blocks. Three annular spaces are machined in the forward gun body around the lube blocks. The rear and center spaces are connected to the gasoline inlet hole. A hole drilled in the forward right-hand side of the forward gun body connects the forward and center spaces. This hole is sealed with a 0.5-inch plug, which must not be removed. These spaces are connected to the secondary fuel inlet on the forward gun body so that the fuel may come in, surround these blocks, and then pass through them to the interior of the gun. These blocks, which are formed of powdered cast iron and are of a predetermined porosity, may be removed and replaced, but care must

be used, since they are very brittle. In order to prevent corrosion, these blocks should be protected as much as possible.

In the aft end of the forward gun body is a metal ring insert, press-fitted into place and not removable, called the main valve seat. The main valve disc seats against this ring. The seating surface of the valve disc is a specially formed fiber ring which is set into the valve lead and held in place by a washer and special lock nut. This fiber disc is replaceable. The valve disc is mounted on a rod or stem which passes through a central hole in the partition across the forward end of the after gun body. Attached to the stem and riding in a cylindrical portion of the after gun

GUN UNIT

O P 1139

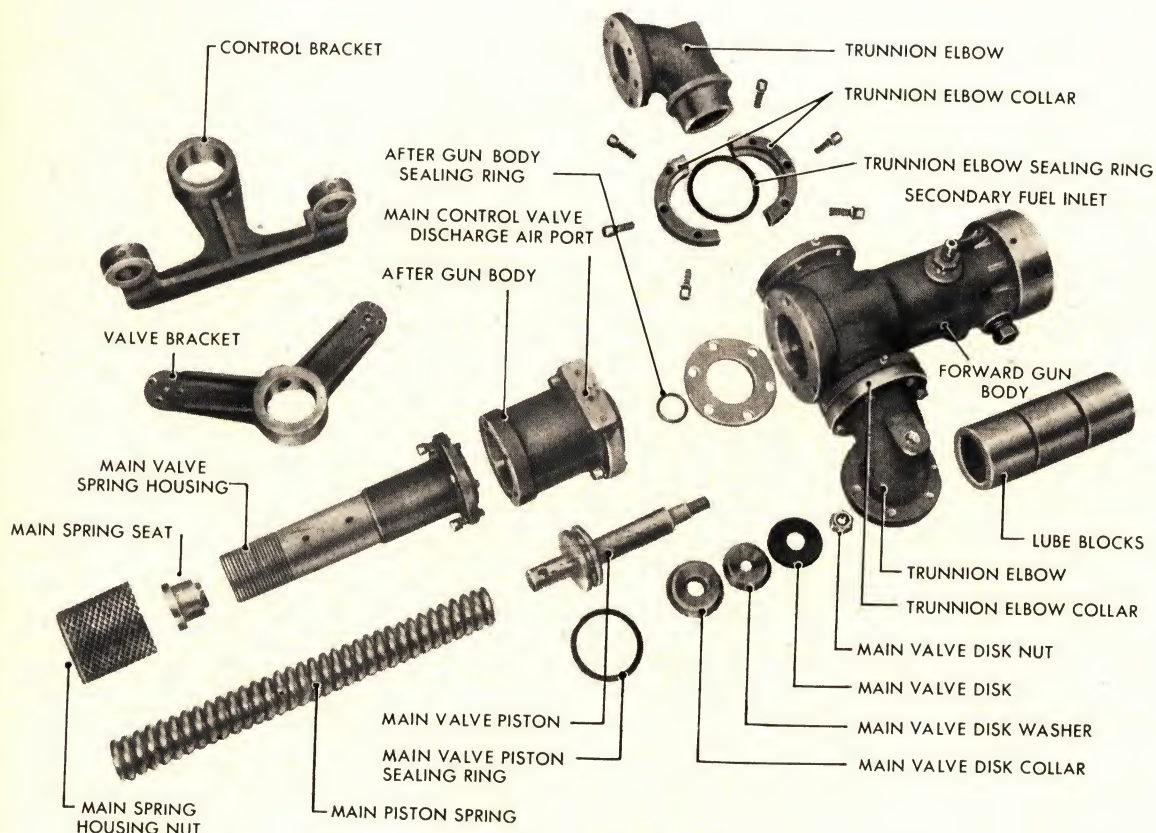


Figure 10.—Flame Thrower Mk 1—Gun Body Disassembled

body is a large-diameter piston. The hole through which the valve stem passes and the periphery of the piston are sealed by special linear packing rings. Air admitted by the main control valve between the piston and the partition forces the valve disc away from its seat, compresses the closing spring, and permits the discharge of fuel to the nozzle of the gun. Attached to the piston on the side opposite the valve stem is a tail rod which serves as a support and centers the closing spring of the main valve mechanism. To limit the travel of the valve, a spacer rod about eight inches long is attached to the retaining cap of the spring housing and extends through the core of the spring. Contact of the piston tail rod and this spacer prevents the valve disc from contacting the partition and sealing to it.

TRUNNION ELBOWS (See Figs. 5 and 10.)

15. The trunnion elbows support the gun and provide for the movement of the gun, by means of linear joints, to a maximum of 45° elevation and 15° depression for the Flame Thrower Mk 1. The amount of safe elevation and depression at various positions in train is determined by the stationary armor plate and the carrying craft outline. A cam to prevent firing into the armor plate or carrying craft should be provided.

MAIN CONTROL VALVE (See Fig. 12.)

16. The function of the main control valve is to provide air to the main fuel valve piston and hence to force it open so that the main fuel or gel may be expelled from the gun. It

simultaneously controls the flow of secondary or lubricating fuel to the lube blocks. Air for operation of the main control valve, itself, is supplied from the pilot valve when the right-hand trigger is pulled. The main control valve body contains two machined liners which cannot be removed. They are cut so that annular spaces are formed between the liners and the valve body. These spaces communicate with the interior of the valve by small holes drilled through the liners. Main air is supplied to the forward annular space. The rear

cylinder delivers air to the main air outlet leading to the gun. The valve discs in the form of a spool are held in the forward position by a spring. Air delivered by the pilot valve enters the forward end of the valve cylinder and forces the valve spool backward, compressing the holding spring. This movement connects the main air inlet with the main air outlet to the main fuel valve in the gun. Secondary fuel for the lube blocks enters through the port side of the bonnet and passes out through the forward end. These two openings

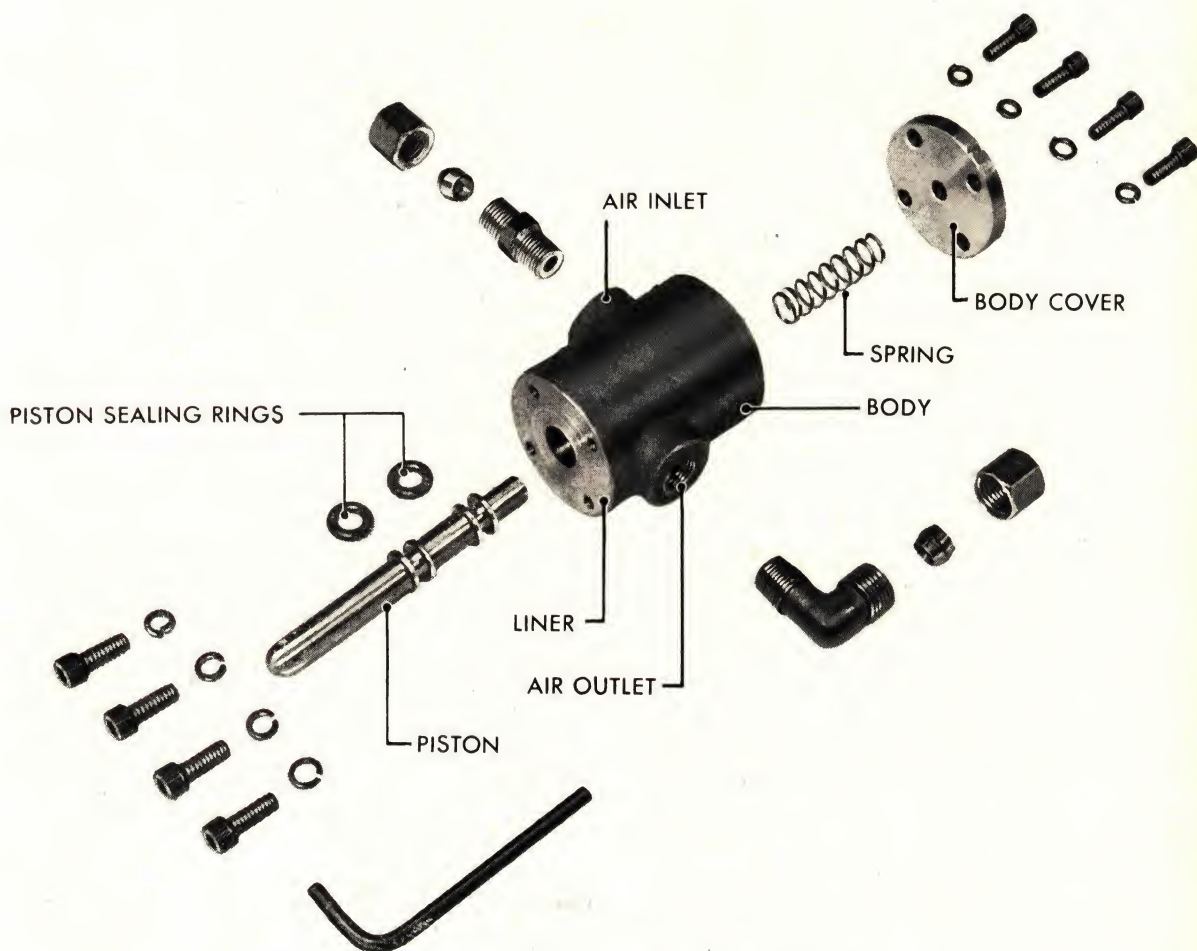


Figure 11.—Flame Thrower Mk 1—Gun Pilot Valve Disassembled

GUN UNIT

O P 1139

are separated by a valve which is closed by the conical end of the piston. The rear opening of the bonnet, through which the piston slides, is made air and gasoline-tight by a linear synthetic rubber sealing ring.

PILOT VALVE (See Fig. 11.)

17. The function of the pilot valve, which is operated by the right-hand trigger, is to supply high-pressure air to actuate the main control valve. For the purpose of description, the pilot valve can be roughly divided into two main divisions, stationary and movable. The former consists of the valve body, liners, and valve body cover. The whole unit is bolted to the valve bracket. The movable parts consist of the piston, spring, and sealing rings. Into each end of the valve body is force-fitted a liner machined in such a way as to leave an annular space between the liner and the valve body. There are two separate spaces so formed; each directly connected to a drilled and tapped port in the valve body, one the inlet, and the other the outlet port. A ring of holes in the liner serves as an air inlet, another as an air outlet. Two piston heads on the piston rod are machined and set about $\frac{1}{2}$ -inch apart.

Set in a groove around the outer edge of each head is a removable linear sealing ring providing an air-tight seal between the piston head and the cylinder. The valve spring is located between the forward piston head and the valve body cover. A hole is drilled into the valve body cover to form an air vent. When the valve is closed, the spring holds the piston in the rearward position and the forward piston head is located between the inlet and outlet rings of holes drilled in the liners. Thus no air can flow between the two sets of holes. When the valve is forced open by the trigger lever, the piston is moved to the forward position and the piston heads bracket the holes, allowing air to flow from the inlet to the outlet ring of holes. When the trigger is released, the piston is returned to the rear position by

the valve spring and the air on the outlet side of the valve is allowed to vent through the hole in the valve body cover.

ATOMIZER CONTROL VALVE (See Fig. 13.)

18. The purpose of the atomizer control valve is to supply air and gasoline to the atomizer. The main body consists of two parts, the atomizer control valve after body and the atomizer control valve forward body. The after body has an air inlet on the after end and an air outlet on the forward end. Two liners are inserted both forward and aft in the after body. These liners are pressed in and cannot be removed. Each has a machined annular groove on the outside and holes connecting this space to the inside. The air inlet and outlet on the after body are directly connected to the annular spaces in the liners. The liners serve as a cylinder for the piston and piston heads.

The forward body is a cylindrical bronze casting having inlet and outlet parts drilled and tapped radially into the body. These parts are separated by a valve disc and its seat. The seat is integral with the body and is conical. The valve disc is likewise conical and is machined on the valve stem. The stem extends in both directions from the disc, the forward extension forming a guide and center for a helical spring. The rear extension passes through a central bore of the body casting and guides the disc to its seat, as well as serving as a tappet for the movement of the valve. Gasoline passing to the atomizer is handled by this valve. The spring is enclosed in a spring housing or valve cap. The after piston with its rings and the gasoline valve disc and stem are inserted in their respective cylinder bodies; the spring placed in its housing; and, after inserting gaskets in the body and cap joints, the assembly is made tight by means of the Allen head through bolts or screws. The action of the trigger on this valve assembly simultaneously releases gasoline and compressed air through $\frac{1}{8}$ -inch

FLAME THROWERS

O P 1139

Figure 12.—Flame Thrower Mk 1—Gun Main Control Valve Disassembled (Above)

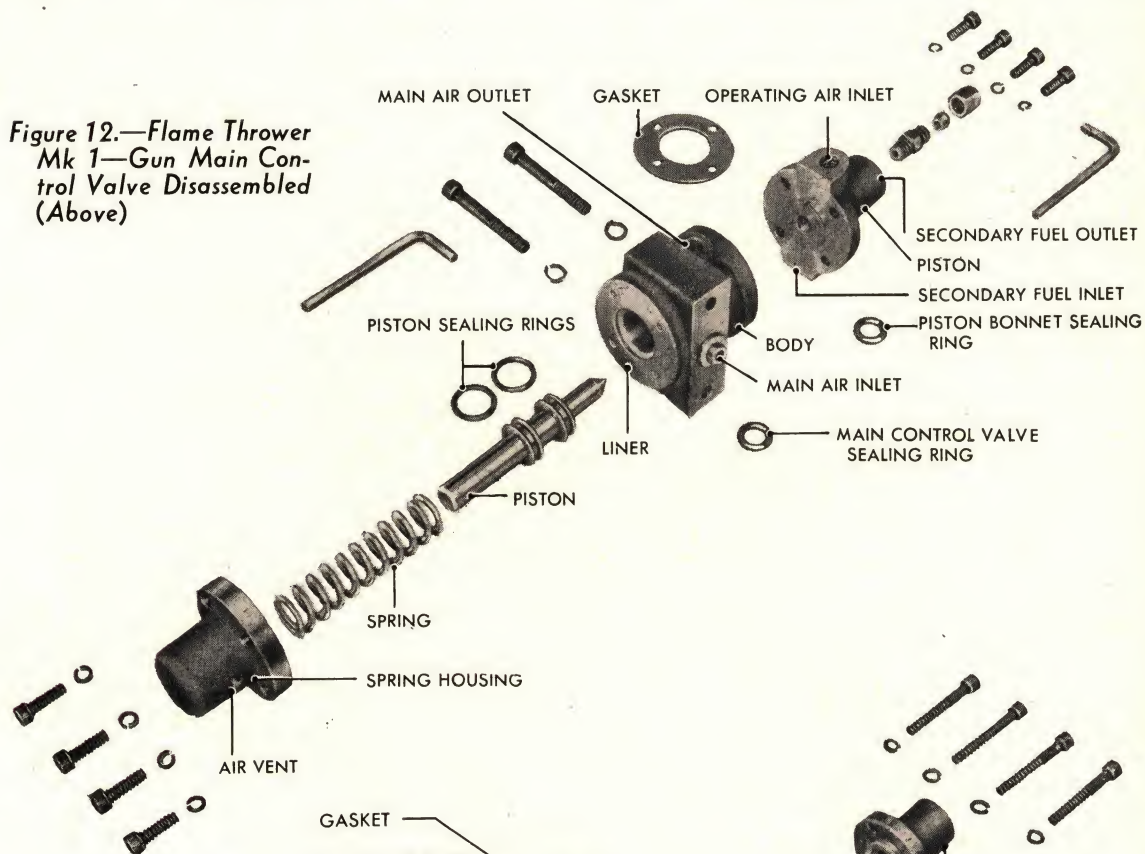
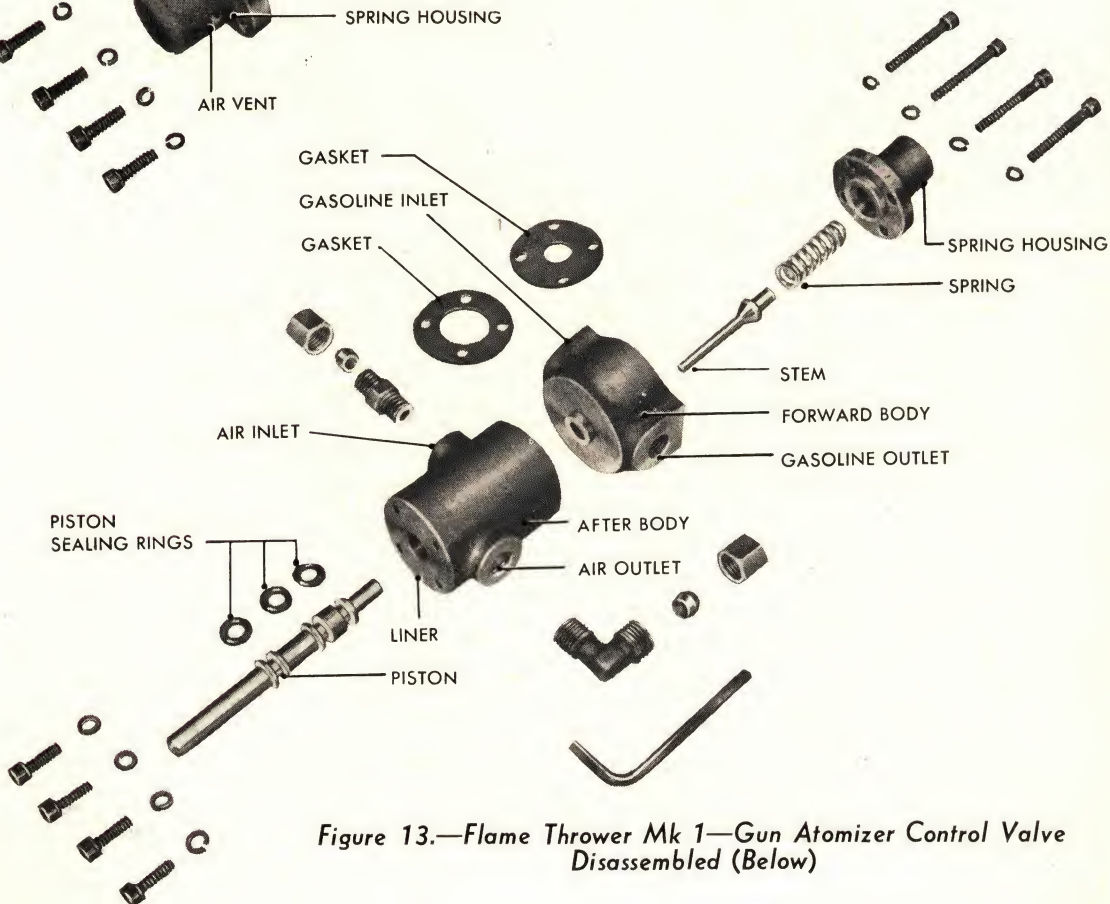


Figure 13.—Flame Thrower Mk 1—Gun Atomizer Control Valve Disassembled (Below)



GUN UNIT

O P 1139

and 1/4-inch O. D. tubing, respectively, to the atomizer in the chimney.

The piston of the after body has two discs or heads sealed by linear rings against the liner. Beyond the discs are piston rods, and the after rod passing through the rear of the body; the forward rod having a slight clearance between

its end and the valve stem of the gasoline valve. The discs of the piston are located so that operation of the trigger moves them forward. This interconnects between the central faces of the discs, the air inlet and outlet parts. Release of the trigger allows the spring to restore the piston to its original position.

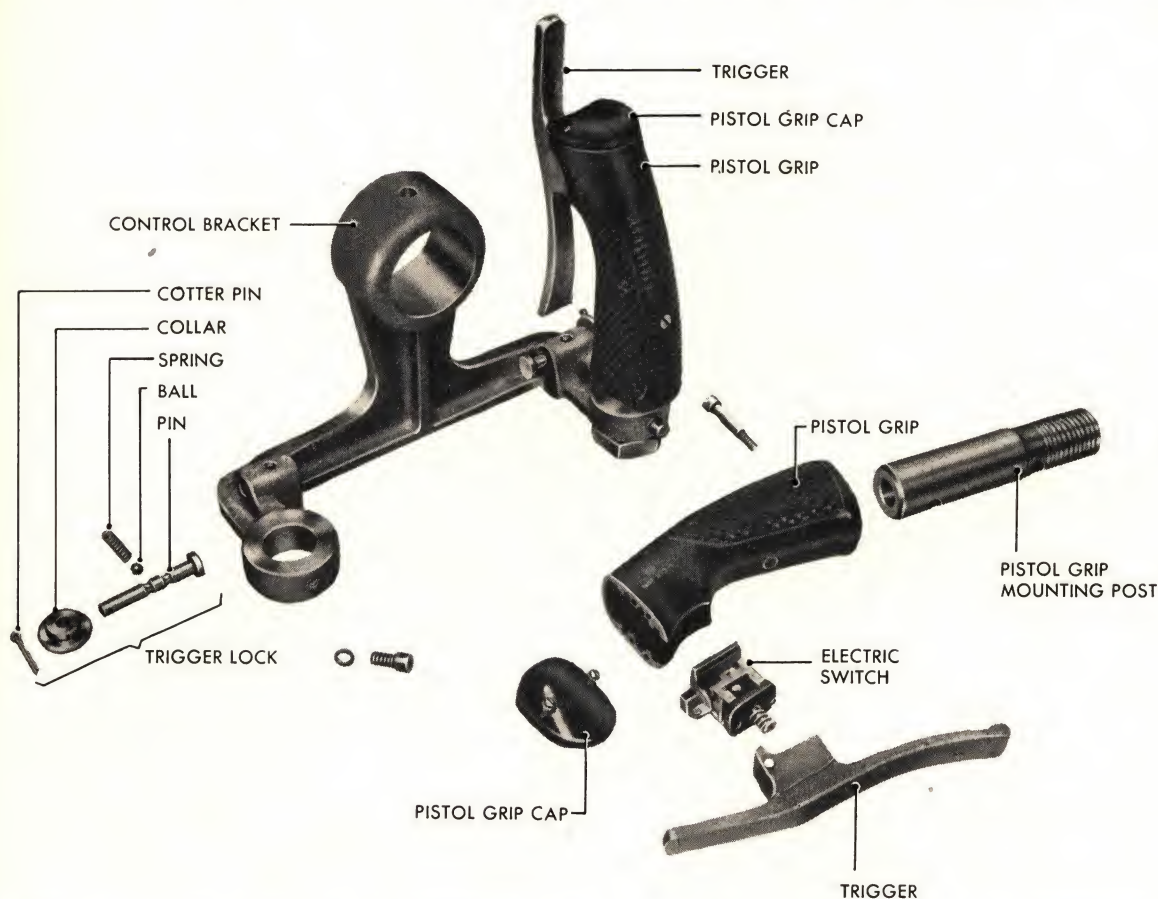


Figure 14.—Flame Thrower Mk 1—Gun Pistol Grips, Triggers, and Trigger Locks—Partial Disassembly

The discs in this position cut off the air supply and vent the air outlet through the clearance between the after piston rod and its guide hole in the after valve body.

TRIGGERS AND PISTOL GRIPS (See Fig. 14.)

19. The triggers set the pilot valve and the atomizer control valves into operation and close the electric switch. The triggers are

identical and consist of long, flat, curved brass castings. A projection on the back with two lugs on its top edge, one on either side, provides a pivot. These lugs fit into slots on the top of the pistol grip and are secured there by the pistol grip cap. The lower portion of the trigger serves as a finger grip. When this is pulled back the upper portion rotates forward as a lever and actuates the piston of either the pilot or the atomizer

valve and switch, depending upon whether the right or left trigger is pulled.

TRIGGER LOCKS (See Fig. 14.)

20. Each trigger lock (or safety) consists of a trigger lock pin, collar, ball, and spring. These parts move horizontally in a housing. The spring holds the ball in one of two grooves in the pin. When sufficient pressure is put

against the trigger lock pin to overcome the pressure of the spring against the ball, the collar and pin slide. When the collar and pin have been pushed to the outboard position, the collar is out of line with the lower end of the trigger and the trigger is free to move. To lock the triggers, the movement is in the opposite direction and the collars block the triggers and prevent their movement.

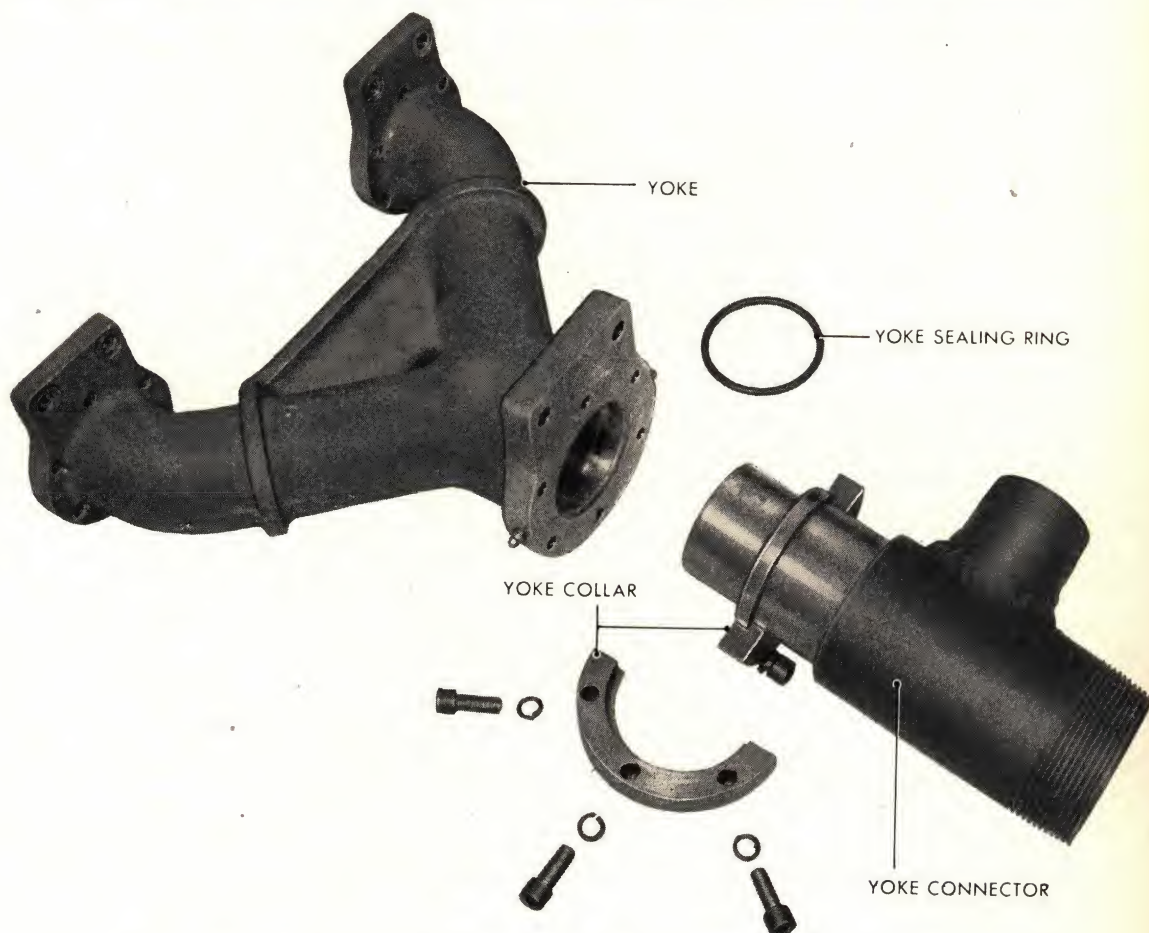


Figure 15.—Flame Thrower Mk 1—Gun Yoke and Yoke Connector Disassembled

YOKE AND YOKE CONNECTOR (See Fig. 15.)

21. The function of the yoke connector (or spud) and the yoke is to conduct fuel from the main fuel tank into the gun when the main fuel valve is opened. The train of the piece is also affected by the movement of the yoke on the yoke connector or spud piece at the linear joint. A sealing ring, Type AN-6227, and collars are provided for this joint. At the top of the yoke the trunnion elbows of the gun are flanged to the yoke by gaskets and bolts, so that the path of the fuel to the gun is up through the trunnion elbows into the forward gun body and out through the nozzle.

DISASSEMBLY AND ASSEMBLY

O P 1139

ARMOR (See Figs. 4 and 4A.)

22. To disassemble the armor, simply unbolt the pieces one at a time, and dismount them. Do not forget the great weight of these steel plates.

GUN AND ARMOR SHIELD (See Fig. 16.)

23. Remove the gun shield. Disconnect the flexible lines that run from the manifold on the yoke connector to the gun at:

(a) Air inlet to the left hand side of the the atomizer control valve after body

(b) Gasoline inlet to the left hand side of the atomizer control valve forward body

(c) Air inlet to the right hand side of the main control valve body

(d) Gasoline inlet to left hand side of the main control valve piston bonnet
Then disconnect the primary ignition wires to left hand control bracket post by disassembly of pistol grip. (See Trigger and Pistol Grips.) Disconnect the secondary ignition leads from the spark coil boxes by opening the bushing. Remove hex socket head cap screws holding trunnion elbows to the yoke. To replace gun, reverse the procedure. Make sure paper gas-kets under trunnion elbows are in good condition and flexible lines and ignition connections are made tight.

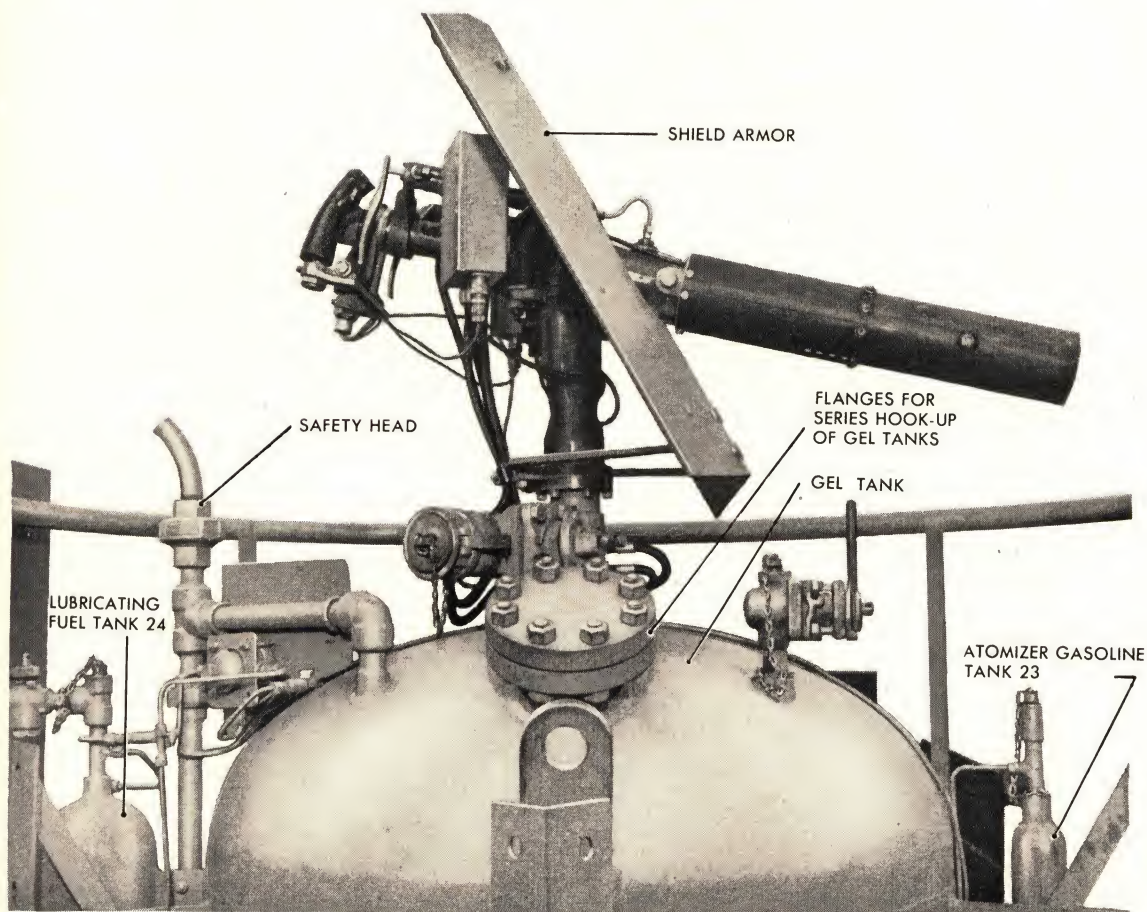


Figure 16.—Flame Thrower Mk 1—Front View of Fuel Unit with Armor Removed and Side View of Guns and Shield Armor Which Trains Gun. Note Flange on Gel Tank in Foreground Which is Used for Series Operation of Two or More Gel Tanks to Provide Greater Fuel Capacity

CONFIDENTIAL

27

DISASSEMBLY
AND ASSEMBLY

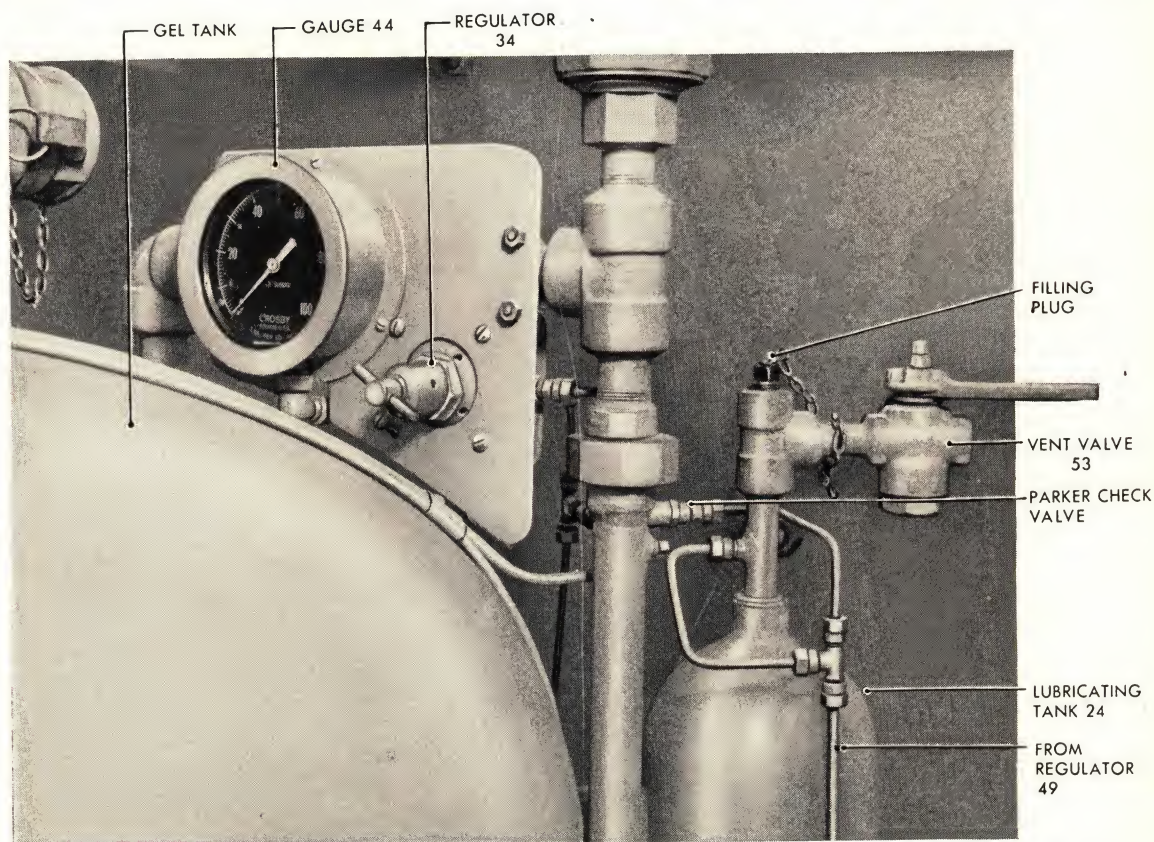


Figure 17.—Flame Thrower Mk 1—Fuel Unit Lubricating Fuel Tank, Atomizer Air Regulator, and Gauge

LUBRICATING FUEL TANK (See Figs. 3, 4, and 16.)

24. Disconnect lead-in and lead-out pipes. Unbolt tank brackets from lugs on gel tank and lift out. It is recommended that this tank not be removed from its connection.

ATOMIZER GASOLINE TANK (See Figs. 3, 4, and 17.)

25. Disconnect lead-in and lead-out pipes. Unbolt tank brackets from lugs on gel tank and lift out. It is recommended that this tank not be removed from its connection.

IGNITION SYSTEM (See Fig. 4.)

26. Unscrew the nuts from the "U" bolts through the wooden brackets holding the battery boxes. Remove the battery box covers, disconnect the bushings, and remove the battery leads. A portion of the primary and the

secondary ignition leads have been disconnected in the removal of the gun unit. If desired, remove battery box and batteries. Remove covers from spark coil boxes. To assemble, reverse the above procedure.

MAIN FUEL (Gel) TANK (See Figs. 1 and 4.)

27. To disassemble the gel tank, disconnect all pipe connections. Remove the armor plate except AP-5-R, AP-5-L, and AP-6. Remove the bolts connecting the tank lugs to the channel iron posts. Lift tank out of unit. To assemble, reverse the procedure.

AIR SYSTEM (See Figs. 2, 3, and 4.)

28. All connections in the seamless steel pipe are brazed except those leading into the high pressure bottles and into the safety valves and regulators. It is recommended

DISASSEMBLY AND ASSEMBLY

O P 1139

that the air system be left intact if possible. On the connections that are not brazed, there is a preparation called "Expando" that forms a very tight seal. To break this seal, tap the connector with a hammer while applying pressure with a wrench.

GUN SUBASSEMBLIES (See Figs. 6 to 11.)

29. To disassemble the ignition chimney assembly of the gun, remove the upper and lower nozzle covers by unscrewing the hexagonal-headed screws. Then remove screw holding atomizer to atomizer clamp. Loosen baffle sleeve clamp. Disconnect spark plug leads. Slide ignition chimney, baffle plate, baffle sleeve, baffle sleeve clamp, and atomizer clamp forward and off the nozzle.

(a) The atomizer can then be removed by disconnecting gas and air leads to the atomizer from the atomizer control valve. (The fittings on the after end of the leads must be cut off.)

(b) The main control valve is disassembled by first removing the secondary fuel line that leads from the forward end of the main control valve piston bonnet to the top of the forward gun body. Then remove the air lines between the main control valve and the pilot valve. Remove the two Allen head cap screws which hold the valve to the after gun body and lift off the unit. Lift the main control valve discharge air port sealing ring out of the main control valve seat in the after gun body.

(c) The atomizer control valve is taken out by removing the four cap screws which hold the unit to the valve bracket.

(d) The pilot valve is taken off by removing the four cap screws holding the unit to the valve bracket. When doing this be sure to **hold the valve unit**, as the compressed valve spring will push it away from the valve bracket.

(e) Pistol grips (triggers) are taken off by removing the slotted lead screw in the grip and lifting off the grip. The trigger locks are part of the control bracket. The trunnion elbows are taken out by remov-

ing the cap screws and the split collars holding the elbows to the forward gun body. Then slide out the elbows, rotating them to prevent damage to sealing rings.

Prior to reassembly, oil all rubber sealing rings with clean light-lube oil. Examine all sealing rings carefully and replace any whose contact surfaces are chipped, marred or scratched, as well as those that fit loosely into retaining chambers or around items in retaining grooves. Replace all damaged gaskets. Reassemble subassemblies to the gun in reverse order.

IGNITION CHIMNEY OF GUN (See Figs. 8 and 9.)

30. The same screws which held the nozzle cover plates to the baffle plate hold the ignition chimney to the baffle plate. When these screws have been removed, slide the chimney off the plate. Then disconnect high-tension ignition wires from base terminals of spark plugs. Using a wrench, unscrew the spark plugs from the baffle plate. Loosen the clamp set screw and slide the clamp back off the baffle sleeve. Remove the grounded electrodes from the chimney with a screw-driver. Assemble in reverse order, being sure spark plug electrodes and grounding electrodes are thoroughly clean.

MAIN CONTROL VALVE (See Fig. 12)

31. To remove the main control valve, first remove the four cap screws holding the spring housing onto the valve body. **CAUTION:** Hold housing tightly, so that the compressed valve spring will not shoot it off suddenly. Then remove main control valve spring and pull out main control valve piston. **CAUTION:** Be careful not to mar sealing rings, or air seal will be broken. Remove four cap screws holding the piston bonnet onto the valve body. Assemble in reverse order, inspecting and oiling all rubber sealing rings. Tighten the screws that hold on the piston bonnet last, to insure correct positioning of the tapered valve seat. Be sure gaskets under spring and piston covers are in good condition.

ATOMIZER CONTROL VALVE OF GUN (See Fig. 13.)

32. The atomizer control valve of the gun is removed by sliding out the air piston assembly, exercising care not to damage rubber sealing rings. Next, remove the atomizer control valve forward body and the atomizer gasoline control valve spring housing from the atomizer control valve after body by removing four Allen head cap screws. These parts are subjected to a separating force by the atomizer control valve spring. Separate the atomizer control valve forward body from the spring housing and remove the atomizer control valve stem and spring. Assemble in reverse order, inspecting and oiling all rubber sealing rings. Be sure gaskets under the spring housing and between valve bodies are in good condition.

PILOT VALVE (See Fig. 11.)

33. To take apart the pilot valve, remove the four hex socket head cap screws holding pilot valve body cover to the valve body, and remove the cover. Remove the pilot valve spring. Remove the pilot valve piston, being careful not to damage sealing rings or score the cylinder walls. To assemble, reverse the above procedure, inspecting and oiling all rubber sealing rings.

TRIGGER LOCKS (Right and Left) (See Fig. 14.)

34. To disassemble the trigger locks, remove the trigger lock cotter pin which holds the trigger lock collar on the outboard end of the trigger lock pin. The trigger lock collar may now be slid out and off. Then remove the trigger lock pin by sliding it inboard. Take out the trigger lock ball and the trigger lock spring. **CAUTION:** Cup hand over hole to catch the ball, which will pop out from spring pressure when the lock pin is slid out.

TRIGGERS AND PISTOL GRIPS

35. Triggers and pistol grips can be removed by loosening the cable bushing at the base of the pistol grip mounting post. Then remove pistol grip cap by removing two slotted head screws on top. Remove trigger from grip. Push cables upward through loosened

cable bushing, which will permit electric switch to be removed from top of pistol grip. Disconnect leads from switch. Unscrew slotted head screw in rear of pistol grip. Slide pistol grip vertically, removing it from mounting post. To reassemble, reverse the above procedure, being careful to make electric connections and bushing secure and tight.

MAIN FUEL VALVE, AFTER GUN BODY, FORWARD GUN BODY AND HOUSING

36. To remove the main fuel valve, after gun body, forward gun body, and housing, unscrew the main spring housing nut. **CAUTION: Hold nut in firmly, as the compressed main spring piston spring will tend to kick if off with about 200-pound force.** Next remove the main spring seat and spacer rod from the main spring housing. Remove the main piston spring. Remove the main valve spring housing (six Allen head cap screws). Remove the control bracket from the housing by taking out the cap screw and sliding the bracket off the rear of the housing. Remove the valve bracket by taking out the Allen head cap screw and sliding the bracket off the rear of the housing. Remove the after gun body (six Allen head cap screws). The main valve piston assembly is held in this after gun body. Preserve the gasket (if in good condition) removed from this joint. Replace if need be. Slide the main valve piston aft and hold the after valve stem with a wrench, to prevent it from rotating, and then remove the valve disc nut with another wrench. This allows the valve disc washer, the valve disc, and the valve disc collar to be removed, successively. The piston rod may now be slid aft, out of the after gun body. **CAUTION: Do not damage the rubber sealing rings while removing.** Next remove the nozzle from the forward gun body (six Allen head cap screws). Examine gasket at this joint. Replace if necessary. Remove the lube blocks from the forward gun body by sliding them forward. Examine the sealing rings and replace those that are scratched, chipped, marred, or loose fitting. Oil the rings upon assembly. To assemble, reverse the above procedure.

INSTALLATION

O P 1139

DESCRIPTION

37. The Flame Thrower Mk 1 was designed for installation in the following type landing craft—LCVP, LCM, or LCT. It is entirely possible, however, for it to be used in other type craft, for example the LVT-3, in which its utility is tremendously increased because of the land operation of this vehicle.

LCVP INSTALLATION

38. The LCVP is the lightest of the boats for which this unit was designed. Hence, the position of the Flame Thrower Mk 1 in this boat is most critical. Two lugs on the fore and aft center line of the unit (See Figs. 4 and 17) have been provided for hoisting. When locating the unit in the LCVP, it is suggested that fore and aft guide lines be painted on the deck of the boat to aid in positioning the unit on the craft. The sides of the craft serve as guides in the athwartship direction. The unit should not be transported by the LCVP with its rearmost point more than two feet forward of the midships bulkhead. Do not place the rear of the unit closer than one and one half feet to the midships bulkhead, in order to allow room for the operator to position himself behind the flame thrower to manipulate valves, watch gauges, etc., during preparation for firing and possibly during actual operation.

Ordinarily the Flame Thrower Mk 1 has 180° of train, 45° of elevation, and 12° of depression. When placed in any craft, however, its direction of fire is somewhat determined by the outline of the boat. Therefore, a cam has been provided for use in the LCVP when the rear of the unit is exactly two feet forward of the midships bulkhead. This cam prevents the firing of the gun in any direction which would hit a portion of the LCVP. It is important to note that the position of the flame thrower in the boat is a critical factor, and the distance from the bulkhead should

be rigidly adhered to or the cam will be of no value whatsoever. Also after positioning the unit in the craft it is wise to check the area protected by the cam, since a difference in boat construction can cause the cam to be of no value.

LCM INSTALLATION

39. As the LCM-3 has more load capacity than the LCVP; the position of the Flame Thrower Mk 1 in this boat is not at all critical regarding trim characteristics. The LCM-3 will easily carry four complete units, provided they are not placed too far forward in the cargo space. Because of the cargo capacity of this craft, it was believed that series operation using one complete flame throwing unit and one fuel assembly would be extremely useful. Experimentation with series operation is now under way, and the fact that the trim of the LCM is not affected by the placing of two units within three feet of one another in the bow of the craft, (provided they are placed on the fore and aft center line) may give the Flame Thrower Mk 1 additional tactical value. No cam is provided for use with the LCM because of the many positions available in this boat for placing the unit. For single operation it is recommended that a platform in the bow be provided, so that the gun may be fired at a horizontal position over the ramp, which is approximately ten feet in height. Even with the unit mounted on a platform, two units may be carried by the craft, provided the second is sufficiently far aft to be consistent with good trim characteristics.

LCT INSTALLATION

40. No trials have been made for installation of the unit in LCT's, as the size of this craft is sufficient for location of the unit at any point consistent with good tactical performance.

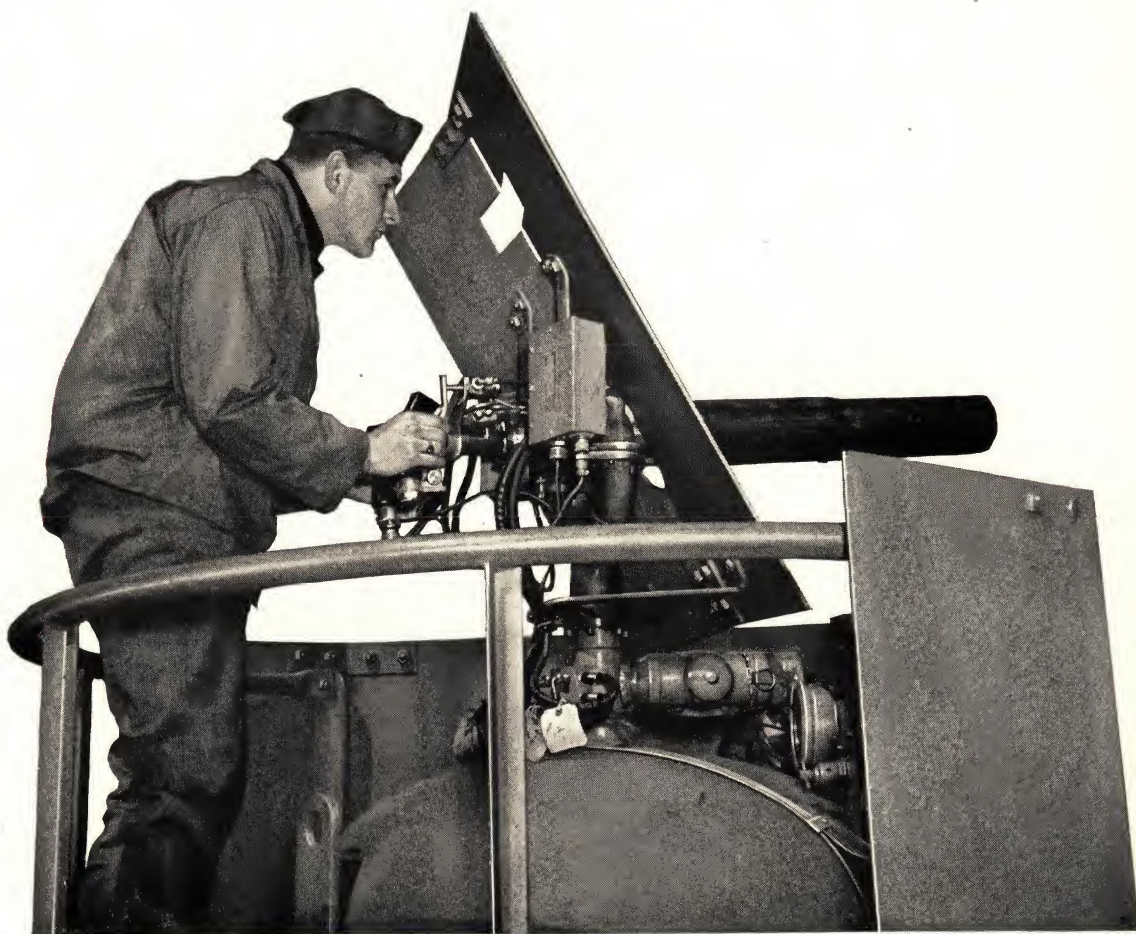


Figure 18.—Flame Thrower Mk 1—Side View, Showing Operator in Firing Position

OPERATION

O P 1139

PREPARING FOR FIRING

41. The check cycle in preparing to fire Flame Thrower Mk 1 includes the following steps:

(a) Make sure that valves No. 37, No. 47, and No. 40 are closed.

(b) Open valve No. 36 slowly, allowing air at 2000 p. s. i. to flow along the main air line to regulator No. 32, where it is reduced to 450 pounds. This reduced pressure is shown on gauge No. 42.

(c) Open valve No. 37 slowly, allowing the 450 pounds air pressure to go on through the main air line. This main air line carries the air pressure on to the gel tank where, when the trigger is pulled, it acts as the expelling force behind the gel.

(d) Open valve No. 47 slowly and allow the air at 2000 p. s. i. to flow to Regulator No. 49. This regulator (No. 49) reduces the air pressure to 550 p. s. i. This reduced pressure is shown on gauge No. 42A. The air flows on to the lubricating fuel tank No. 24, where it acts as the expelling force to push the lubricating fuel up to the gun.

FIRING

42. The firing cycle of operation for Flame Thrower Mk 1 is as follows:

(a) **Make certain** that there is nothing in front of the gun that you do not wish to destroy.

(b) Release the safety catch on the **ignition trigger only** (left hand trigger).

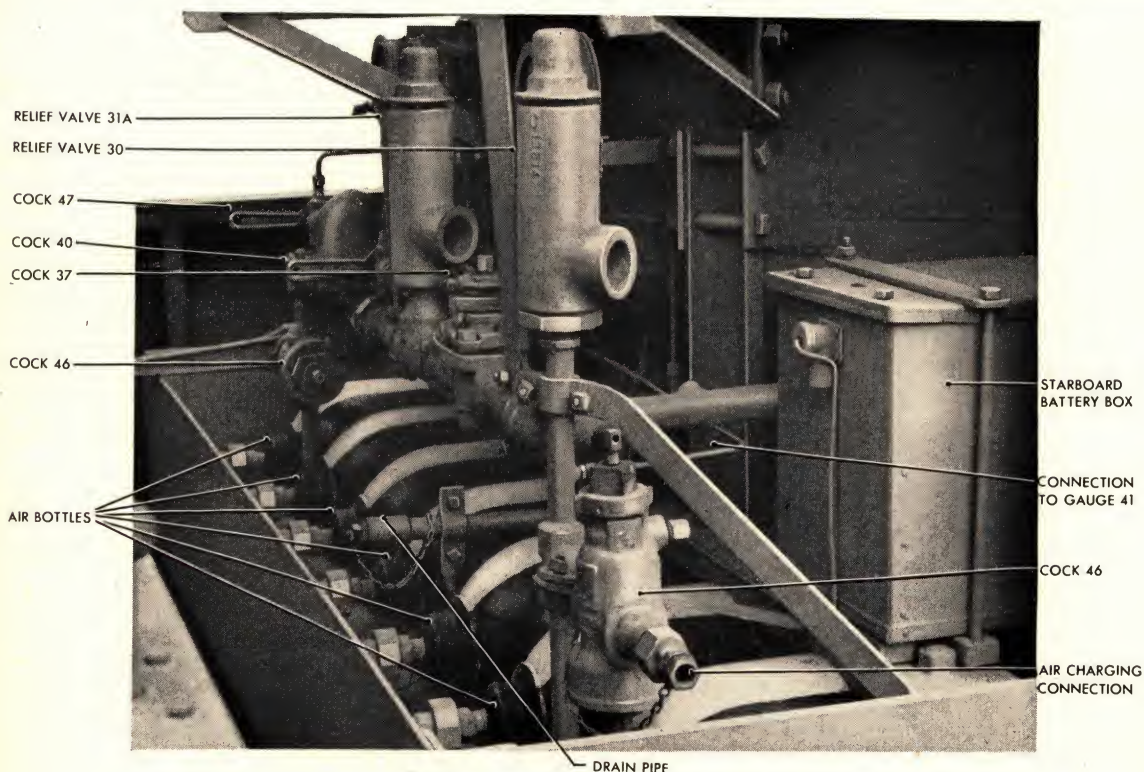


Figure 19.—Main Air Line, Showing Starboard End and Cocks in Closed Position

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(c) Press trigger and test the ignition flame. When ignition trigger is pulled:

(1) A contact switch in the handle of the trigger is closed, completing an electrical circuit between the batteries and spark coils. At the spark coils, the voltage is stepped up to 12,000 volts and sent to spark gaps in the chimney.

(2) The piston of the atomizer valve is forced forward, causing the piston ring to uncover air-outlet port and allow air under a pressure of 65 p. s. i. to flow from regulator No. 34 to the atomizer head. This causes gasoline under a pressure between three and five p. s. i. to flow to the atomizer head No. 13, where the gasoline and air are mixed so as to be ignited by the high tension sparks in the chimney.

(d) If atomized gas does not ignite after the trigger has been pulled, stand 8 to 10 feet in front and slightly to one side of muzzle and observe whether spark is visible on spark plugs when ignition trigger is pressed. **You are again reminded that the gel or main fuel trigger (RIGHT HAND TRIGGER) should be on "SAFE" and should not be touched at this time. Very serious injury and probably death would result if a man were struck by the fuel rod, whether ignited or unignited, at any range up to 50 or 60 yards.** If there is no spark, check all battery and electrical connections. If the sparks appear but the gasoline vapor does not ignite, adjust regulator valve No. 34, allowing more or less air to enter the atomizer until the vaporized gasoline ignites. If ignition still fails, check position of atomizer nozzle and see that the stream of vaporized gasoline is directed along center line of chimney. See that tip of atomizer nozzle is set at least $\frac{3}{4}$ inch to 1 inch behind rear baffle wall. If spark appears but there is no vaporized gasoline, make certain that valve No. 40

has been turned on and that regulator No. 33 is set for four pounds as shown on gauge No. 45.

(e) Release safety on gel trigger (right hand trigger).

(f) Make sure that range is clear.

(g) When gel trigger is pulled (right hand trigger), the piston of the pilot valve is forced forward, allowing air under a pressure of 425-450 p. s. i. to flow to the main control valve located above the gun. This air forces the piston of the control valve aft, causing the needle valve to open and allowing secondary fuel under a pressure of 500-550 p. s. i. to flow to lube blocks located aft of the gun nozzle. The position of the piston also allows air under a pressure of 425-450 p. s. i. to flow to the main fuel valve located in the gun. This air, flowing into the chamber between the fuel valve piston and a bulkhead in the gun body, overcomes the force of the fuel valve spring and causes the fuel valve head to move aft, which in turn allows the gel under a pressure of 425-50 p. s. i. to flow past the lube blocks and out of the nozzle through the chimney, where it is ignited by the atomizer flame.

(h) If the rod of fuel is not fully ignited, check the following:

(1) Crosswind will cause poor ignition.

(2) Headwind will cause poor ignition.

(3) Check to see that valve No. 47 is open.

(4) Check to see that regulator No. 49 is set.

(5) Increase pressure on lubricating fuel tank through regulator No. 49 to a maximum of 500-550 pounds.

(i) In the complete cycle of gun operation, when the ignition trigger (left hand) is pulled, three things happen. The upper lever of the trigger forces the atomizer control valve piston forward, compressing the valve spring. The front

OPERATION

O P 1139

piston head which was between the sets of holes to the air inlet and outlet is moved forward so that the two piston heads bracket these holes. Air taken from the air system at about 65 p. s. i. flows through the inlet and the circular groove and holes in the after liner to the space around the piston. From here it flows out of the holes and circular groove in the forward liner and out the right hand outlet to the atomizer. Simultaneously, the piston pushes the valve stem forward off its seat in the atomized forward body. Gasoline under pressure of about four p. s. i. is then allowed to flow from the $\frac{1}{2}$ -gallon atomizer fuel tank through a strainer into the inlet on the left hand side of the forward body and out the outlet on the right hand side to the atomizer. At the atomizer, the air and gas are mixed and sprayed through the baffle plate into the ignition chimney.

Also, as the left trigger is compressed, the electric switch in the pistol grip is closed. Electricity flows from two six-volt standard storage batteries which are connected in series to give 12 volts, through the electric switch to the spark coils. One wire leads up into the left control bracket post from the batteries, and two lead down out of the post, one going to each spark coil. These spark coils step the voltage up to about 12,000 volts, which is delivered to each spark plug in the ignition chimney. Since the system is grounded at the battery, the electricity sparks across the $\frac{1}{16}$ -inch gap between the end of the spark plugs and ground electrodes which are set in the sides of the ignition chimney. These sparks ignite the air and gas spray from the atomizer nozzle.

When the fuel trigger (right hand trigger) is pulled, the pilot valve piston is moved forward, compressing the valve spring and allowing the forward piston head to uncover the air outlet holes in the forward liner. Air at 450 p. s. i. is sup-

plied to the inlet of the pilot valve by tapping it off the inlet line going to the main control valve. From here it flows into a circular groove machined on the outside of the after liner. This liner has holes leading to the space around the pilot valve piston rod. The air then flows through the holes and the circular groove in the forward liner to the air outlet of the pilot valve and thence to the right-hand side of the main control valve piston bonnet. When air at 450 p. s. i. from the pilot valve reaches the main control valve through the piston bonnet, it enters a space between the forward piston head and the rear partition of the piston bonnet and forces the piston aft.

As this piston moves aft, two things happen. Air from the main air inlet at 450 p. s. i. enters the right-hand inlet in the valve body, passing through the circular groove and holes in the forward liner and into the space around the piston. It then passes through the holes and circular grooves of the after liner and down through the outlet in the bottom of the valve body into the interior of the after gun body. Also, as the piston moves aft, gasoline from the three-gallon secondary fuel tank at a pressure of about 550 p. s. i. enters the main control valve piston bonnet on the left-hand side and passes around the conical shaped forward end of the main control valve piston rod and through the valve port in the piston bonnet.

Having passed through this needle valve, the secondary fuel passes out through the forward end of the bonnet and enters the inlet on top of the forward gun body. It passes down through here to circular spaces machined in this forward gun body around the porous lube blocks. The pressure on the secondary fuel causes it to pass through the lube blocks into the interior of the forward gun body. To insure flow of secondary fuel through the lube blocks, its pressure

must be greater at the lube blocks than that of the primary fuel. The greater the differential of pressure used between the secondary and primary fuels, the greater the rate of flow of secondary fuel. A separate air line and regulator to the secondary fuel tank provides a means of controlling the amount of the differential pressure.

When air flows down into the after gun body from the main control valve, it enters a chamber between the forward partition of the after gun body and the piston head of the main valve piston. The 450 p. s. i. air forces the piston back, compressing the main piston spring. This draws the main valve disc head back from its seat in a partition in the forward gun body. This, in turn, allows the primary fuel to be forced by the 450 p. s. i. tank pressure up through the yoke, through the trunnion elbows, into the after part of the forward gun body, through the main valve port, and out the nozzle through the ignition chimney.

As the primary fuel passes through the lube blocks, it receives a coat of secondary fuel. This coat helps to ignite the fuel rod as it passes through the ignition flame in the chimney. The unit will operate for approximately 75 seconds, at which time the main fuel is exhausted. To cease fire, both the left- and the right-hand triggers are released simultaneously. This permits the pistons in both the atomizer and the pilot valves to move aft under the action of their springs and breaks the electrical circuit leading to the spark plugs. With the atomizer valve closed, no air or gasoline can pass to the atomizer. Together with the breaking of the electrical circuit, this shuts off the ignition flame. When the pilot valve is closed, the air supply that opens the

main control valve is shut off. The main control valve piston, having no air pressure to hold it open, moves forward to its closed position under the action of its spring. With the main control valve closed, no more pressure is available to hold the main valve piston open. Therefore, it closes under the action of the main valve piston spring. This rapid closing of the main valve piston insures an instantaneous break in driving pressure behind the main fuel in the forward gun body, thereby preventing dripping from the nozzle into the ignition chimney. This also prevents dropping off of range of the last particles of fuel. As the main valve piston is closed, the air that opened it is vented back into the main control valve and out of a hole in the main control valve spring housing. The air that opened the main control valve is vented back into the pilot valve and through a hole in the valve body cover.

PROCEDURE AFTER FIRING

43. Upon exhausting contents of the gel tank, this procedure should be followed before refueling:

(a) Close valve No. 36, thus shutting off the air supply.

(b) Open vent valve No. 39 and allow air pressure to bleed off from the gel tank and main air line completely.

(c) Open the filling connection above the atomizing tank. Since there are only four pounds of pressure on this tank, there is no danger in opening this plug without first exhausting the pressure.

(d) Open vent valve No. 53 and allow air pressure to bleed off of lubricating fuel tank No. 24.

(e) Close vent valve No. 53. To refuel, follow directions in Paragraph 44.

FUEL SERVICING

O P 1139

SPECIFICATION FOR THICKENED FUEL USED IN FLAME THROWER MK 1

44. Fuel used in the Flame Thrower MK 1 may be either thickened gasoline or an unthickened inflammable liquid such as kerosene. Another commonly used unthickened fuel consists of a mixture of $\frac{1}{3}$ gasoline, $\frac{1}{3}$ kerosene, and $\frac{1}{3}$ bunker oil. For effective use at long ranges (over 35 yards) thickened fuel must be used. The proportion of thickener in the gasoline may be varied, but for efficient operation of this unit at moderate or warmer temperatures (from 40F to 120F) an approximate 7 per cent mixture of Napalm and gasoline is recommended.

Thickened gasoline for the Flame Thrower Mk 1 shall be dry and homogeneous and shall contain approximately 7 per cent by weight of thickener (of the quality specified in the Chemical Warfare Service Specification No. 196-131-107A issued October 25, 1943) and approximately 93 per cent by weight of gasoline meeting U. S. Army specification No. 2-103B. Exceptions to this specification are that the aniline point (ASTM D611-43T) shall be between 85-115F and that tetraethyl lead need not be added, provided the unleaded gasoline will permit at least 80 ASTM motor octane rating with less than three cubic centimeters of tetraethyl lead per gallon. The consistency of the thickened gasoline shall be between 475 and 625 grams Gardner after aging 24 hours at 150F when tested as described in Chemical Warfare Service Specification No. 196-131-107. The Gardner instrument shall be calibrated and operated as described in Chemical Warfare Service Directive 201A. More detailed specifications may be obtained from the Bureau of Ordnance Specification for thickened fuel.

PREPARATION OF THICKENED FUEL

45. Ordinarily, thickened fuel will have been already prepared for service in 55 gallon drums. If fuel is to be thickened in the field, the following items are necessary:

- (a) I. C. C. 5A 55 gallon drums
- (b) One non-galvanized drum open at one end
- (c) One wooden paddle
- (d) One non-galvanized pail
- (e) Gasoline (any ordinary automotive gasoline)
- (f) Napalm (soap used for the thickening of the gasoline)
- (g) One funnel

Mixing should take place at a temperature of from 70° F to 90° F. Extreme care should be taken that no water is present in the mixing container; and both the gasoline and the Napalm should be thoroughly dry. Napalm is very hygroscopic (water absorbing), and hence the tins of this material should not be opened until the time for mixing is at hand. Pour approximately 22 gallons of gasoline into the open end drum and add to it immediately the contents of two packages of Napalm (unit net weight five pounds four ounces). This proportion will give an approximately seven per cent mixture by weight. Stir vigorously until the mixture has thickened enough to prevent rapid settling of the Napalm particles.

Transfer the mixture into the storage drums (I. C. C. 5A black iron) by means of the non-galvanized pail and a funnel. By repeated mixings, several drums of thickened fuel may be prepared, stoppered, and stored in a moderately warm place for 24 hours if practicable. Satisfactory gel may be obtained, however, with only two hours of storage. No more than 50 gallons of thickened fuel should be put into any one drum. Thickened fuel so prepared is stable in storage for several months.

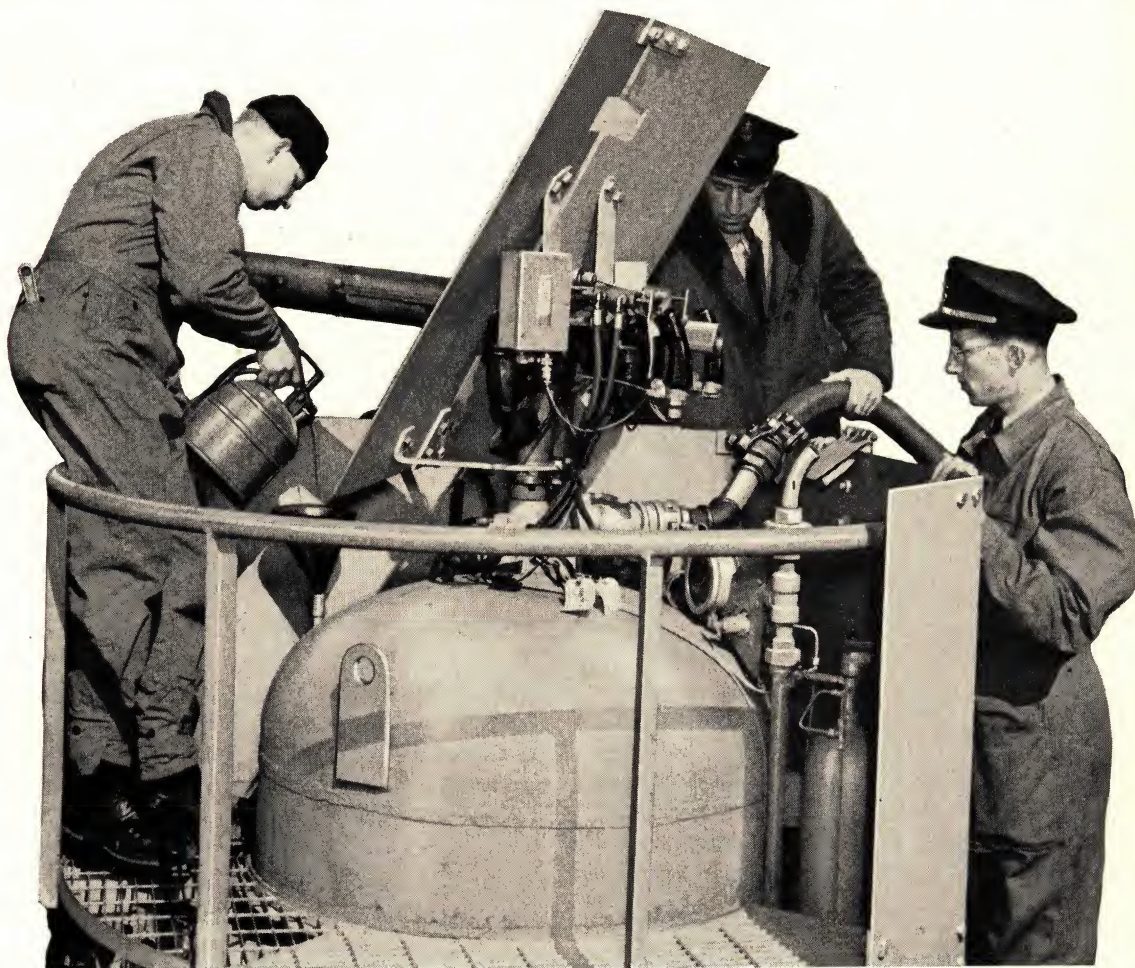


Figure 20.—Flame Thrower Mk 1.—Refueling Gel and Atomizer Gasoline Tanks

DESCRIPTION OF THE FUEL SERVICING UNIT

46. Equipment needed for the fuel servicing unit includes:

(a) Four 55-gallon drums, type I. C. C. 5A, each containing approximately 50 gallons of thickened fuel of specification listed above. This type of drum is capable of withstanding an internal pressure not to exceed 40 pounds per square inch. **Do not overload.**

(b) A source of 60–100 p. s. i. compressed air. Since it is anticipated that fueling will take place generally from the mother ship, an air line of this type should be available.

(c) One Quimby Screw Pump with Electric Motor Drive unit. This fuel pump is driven by a 7.5 H. P. electric motor. A 75-foot electric cable brings 230 volts D. C. power from the ship's line to a fuse box mounted on the pump assembly. In addition to two fuses, this box contains a switch to turn the power on and off. The position of the switch is shown by an indicator on the cover. The cover must be lifted to throw the switch and must be closed to allow the switch to operate. From the fuse box, this electric power is routed through a rheostat which is used to start the motor. A pointer on the outside of this box is linked with a control lever on the inside

FUEL SERVICING

O P 1139

and is used to set it in any one of three positions, **OFF, START, RUN**. The electric motor is V-belted to a drive shaft which is coupled to the main pump shaft. The pump is a positive displacement screw type. Be sure that the pump rotates in the direction shown by the arrow attached to the pump body. The pump suction is fitted with a three-way valve which allows one or the other of two openings to be used while keeping the other closed. Two cuts on the valve stem show which opening is being used and which is shut off. Hoses are connected to these openings so that they may be attached to the two-inch bungs of the fuel supply drums. A gauge (0-200 p. s. i.) on the pump's outlet pipe shows the discharge pressure. A bypass from the outlet side of the pump to the inlet side has a relief valve set in it which opens if the pressure on the pumped fuel should rise to 220 p. s. i. This prevents rupture of the discharge hose if the fuel passing out of the pump is blocked by the valve at the end of the hose.

Mounted on the pump is a control system for the low-pressure compressed air used to displace thickened fuel from the supply drums. Air from the ship's regular 60-100 p. s. i. compressed air system is carried by hose through a pressure regulator (set for 30 p. s. i.) and a gauge (0-50 p. s. i.) followed by a safety valve set to pop at 55 p. s. i. High-pressure compressed air must not under any circumstances be used on this system.

Thirty p. s. i. air from the regulator is piped to a three-way valve, to permit delivery of this air to either of two hoses while keeping the other shut off. These hoses lead to the three-way valve on the connectors which are made up to the ¾-inch bungs of the fuel supply drums. A vent hose is also connected to the latter three-way valve to carry vented air away from the electric motor while relieving air pressure from air empty fuel drum.

(d) Two four-foot lengths of two-inch fuel hose and three 20-foot lengths of three-inch hose with a two-inch bronze cock on the end of one length.

(e) Two 25-foot lengths of ½-inch air hose and two four-foot lengths of ½-inch air hose. A ship's air hose to bring low pressure air to the unit from the ship's supply line.

(f) Four ¾-inch connectors—one to be screwed into the ¾-inch bung hole of each supply drum. Since some drums are fitted with bungs of the the eight thread per inch variety and others fit 14 threads per inch ¾-inch bungs, adapters will be provided. The connectors consist of a 30-inch length of tubing, one end of which is screwed into the ¾-inch bung hole, and a three-way bronze cock equipped with "Evertite" hose couplings. Also, four two-inch connectors—one to be screwed into the two-inch bung hole of each supply drum. These connectors carry a two-inch bronze cock and "Evertite" hose couplings.

LOADING THE GEL TANK

47. To load the main fuel (gel) tank, connect the pump and four fuel drums with fuel tank, with drums on end. Screw the ¾-inch connectors into ¾-inch bungs and screw the two-inch connectors into two-inch bungs, making sure that all cocks are closed. Roll the drums onto a rack or other support so that the two-inch connectors are at the lowest point, with the drums tilted at an angle of at least 30° with bungs at lower end, as shown in Fig. 21. Connect ship's 60-100 p. s. i. air hose to the inlet of the air control system on top of the pump. Make up ½-inch "Evertite" air hose connectors to deliver 30 p. s. i. air through the hose to the ¾-inch bungs of the drums. Make up a ½-inch "Evertite" air hose connector to the 25-foot lengths of the vent hose, and direct the vent hoses away from the electric motor. Make up a two-inch "Evertite" fuel hose connector to the four-foot pump suction hose. Make up a three-inch coupling, connecting 60 feet,

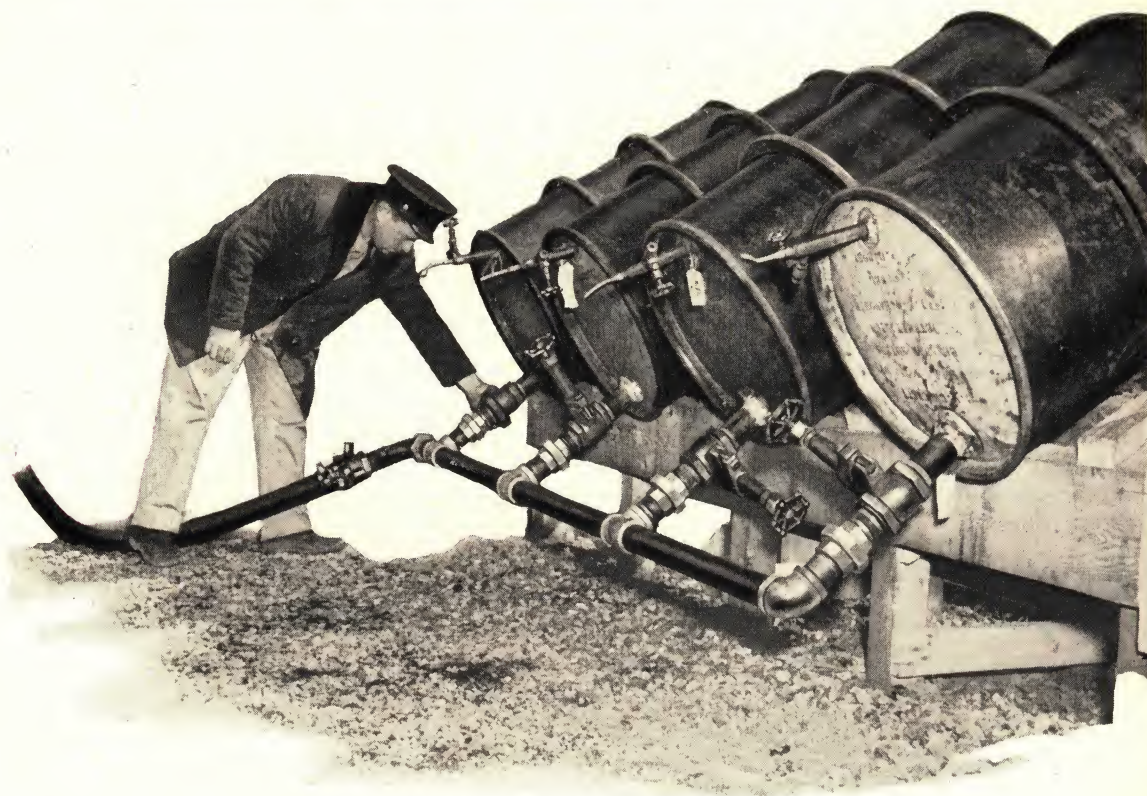


Figure 21.—Four Drums Mounted on a Typical Rack for Loading the Main Fuel Tank with Gel

if necessary, of three-inch discharge hose from the pump. Connect other end of the three-inch hose (carrying a two-inch bronze cock) to the filling valve on the gun's fuel tank. Then connect the electric cable to the ship's electric line and close the switch (Operating lever should be in "STOP" position). Check and set the valves as follows:

- (a) Be sure there is no pressure on the main fuel tank.
- (b) Open the fuel tank vent valve, making sure that the vent hose is attached, with the outlet end over the side of the armor.
- (c) Open the fuel tank filling valve.
- (d) Open the two-inch cock on the end of the three-inch fuel hose.
- (e) Turn the pump suction valve to one of the fuel drums.

(f) Turn 30 p. s. i. air supply cock to the same fuel drum as in (e), making certain that the regulator is set to deliver air at 30 p. s. i.

(g) Turn the cock on the fuel drum so that 30 p. s. i. air will flow into the drum and pumping operations can begin.

(h) Turn on the ship's air supply at the inlet to the air control system and note that the regulator is set at 30 p. s. i.

(i) Move the pointer on rheostat to "START".

(j) Gradually move pointer up to "RUN".

(k) Note that pump discharge pressure is below 200 p. s. i.

The compressed air at 30 p. s. i. will force the thickened fuel into the pump, and it in turn

FUEL SERVICING

O P 1139

will force the thickened fuel into the fuel tank at about 25 gallons per minute. After about two minutes the barrel will be empty. A sudden drop of the gauge on the discharge pipe will indicate that only air is being passed through. Then turn the 30 p. s. i. air supply cock to the second fuel drum and vent the empty drum. Repeat the procedure on each successive drum until all four are transferred to the fuel tank of the unit. To disconnect the drums, take the following steps:

- (a) Vent low pressure air from drums and disconnect them.
- (b) Close fuel filling valve on main fuel tank.
- (c) Close two-inch cock on end of three-inch fuel hose.
- (d) Disconnect fuel hose from fuel filling valve, and secure the gun by making sure fuel filling valve is closed tightly and screw in plug. Shut the fuel tank vent valve. Remove the vent hose. Open the valve No. 36 in the main air line leading out of the air bottles to

restore air pressure to the system. This is done on completion of **all fueling and charging.**

LOADING THE LUBRICATING FUEL AND ATOMIZER GASOLINE TANKS

48. The lubricating fuel and atomizer tanks are loaded by closing valves No. 36, No. 40, and No. 47 and opening vent valve No. 53 to relieve any pressure in the lubricating fuel tank. Unscrew the filling connections on Tanks No. 23 and No. 24. Fill tanks with straight gasoline (unthickened), using the funnels provided. The capacity of tank No. 24 is three gallons and of tank No. 23 is $\frac{1}{2}$ gallon. It is vital that this gasoline be free from any dirt or foreign particles whatsoever, and it should be strained before placing in these tanks. Dirt or water in this gasoline can cause partial or complete failure in the operation of this unit. Replace the filling connections securely and close valve No. 53 when the entire fuel system is properly filled.

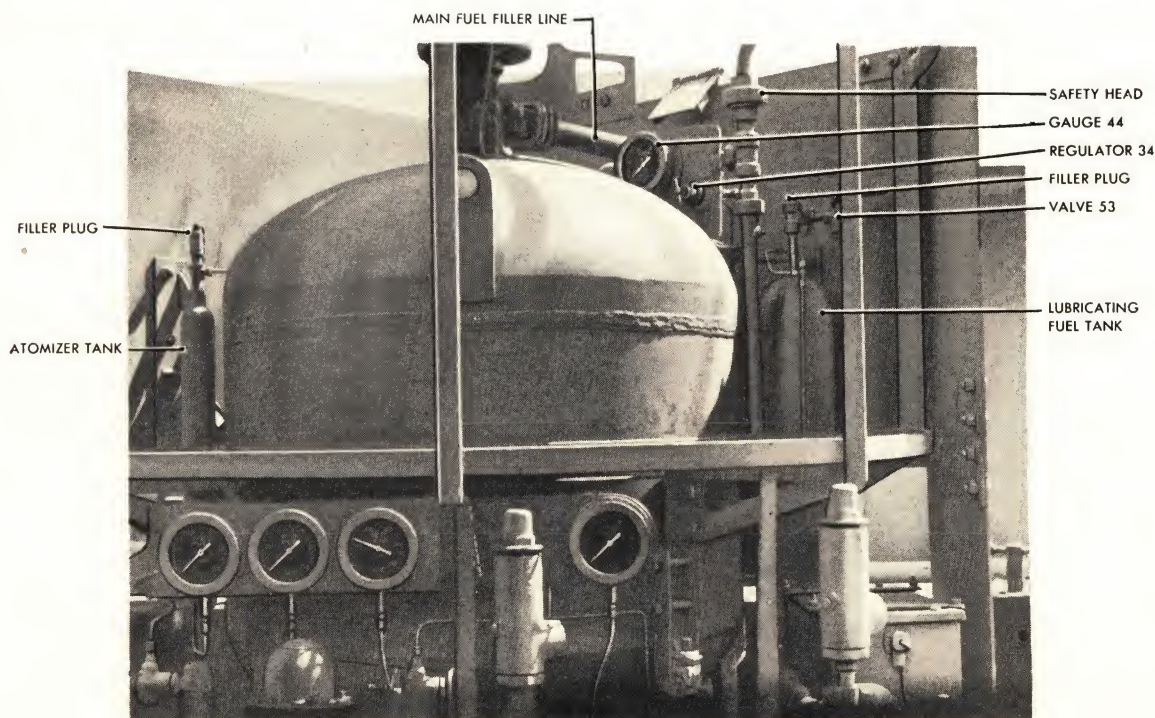
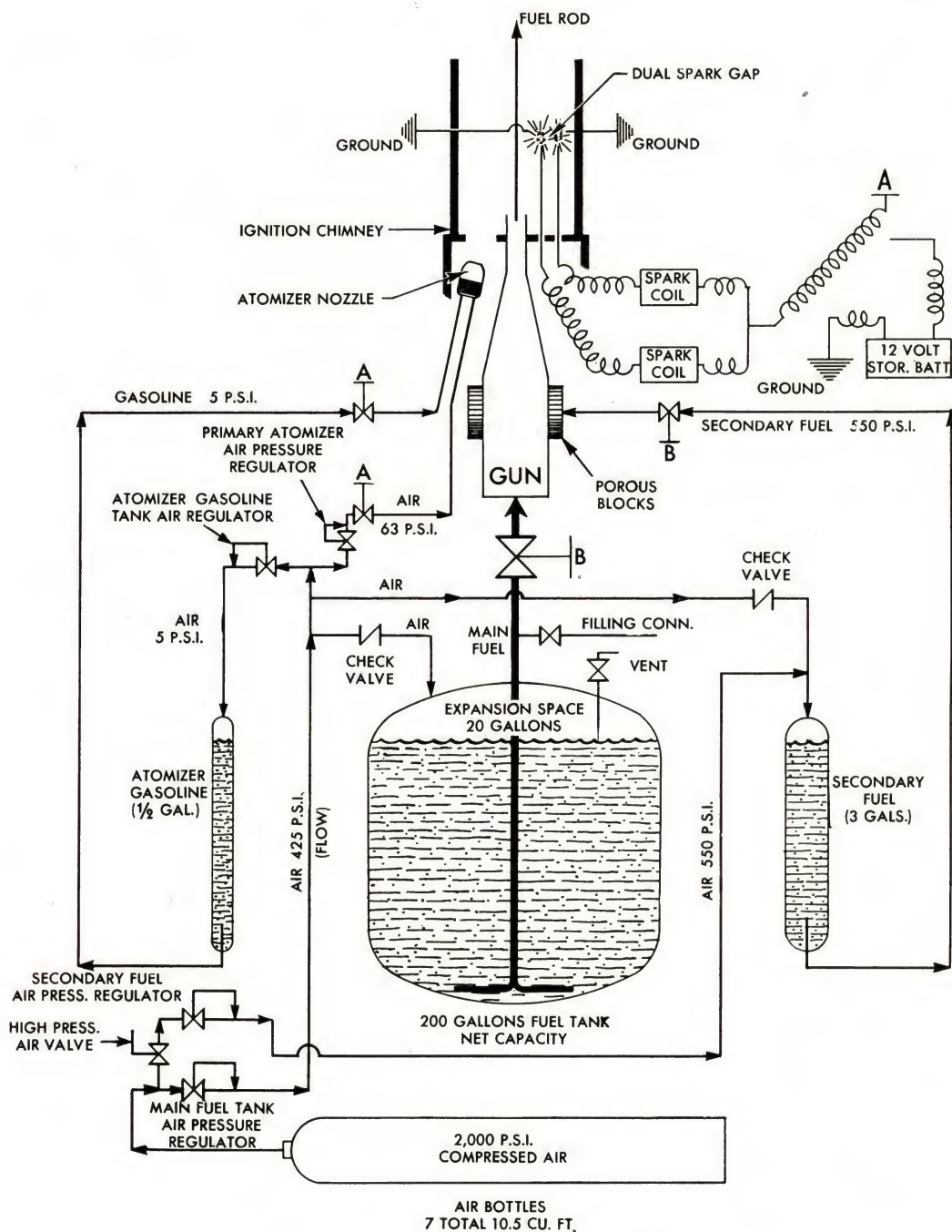


Figure 22.—View of After End of Fuel Unit, Showing Filling Lines

CONFIDENTIAL

41

FLOW DIAGRAM



NOTE:—

A — = VALVE OR SWITCH OPERATED BY LEFT HAND (IGNITER) FIRING TRIGGER.

B — = VALVE OPERATED BY RIGHT HAND (FUEL) FIRING TRIGGER.

Figure 23.—Flame Thrower Mk 1—Flow Diagram

AIR SERVICING

O P 1139

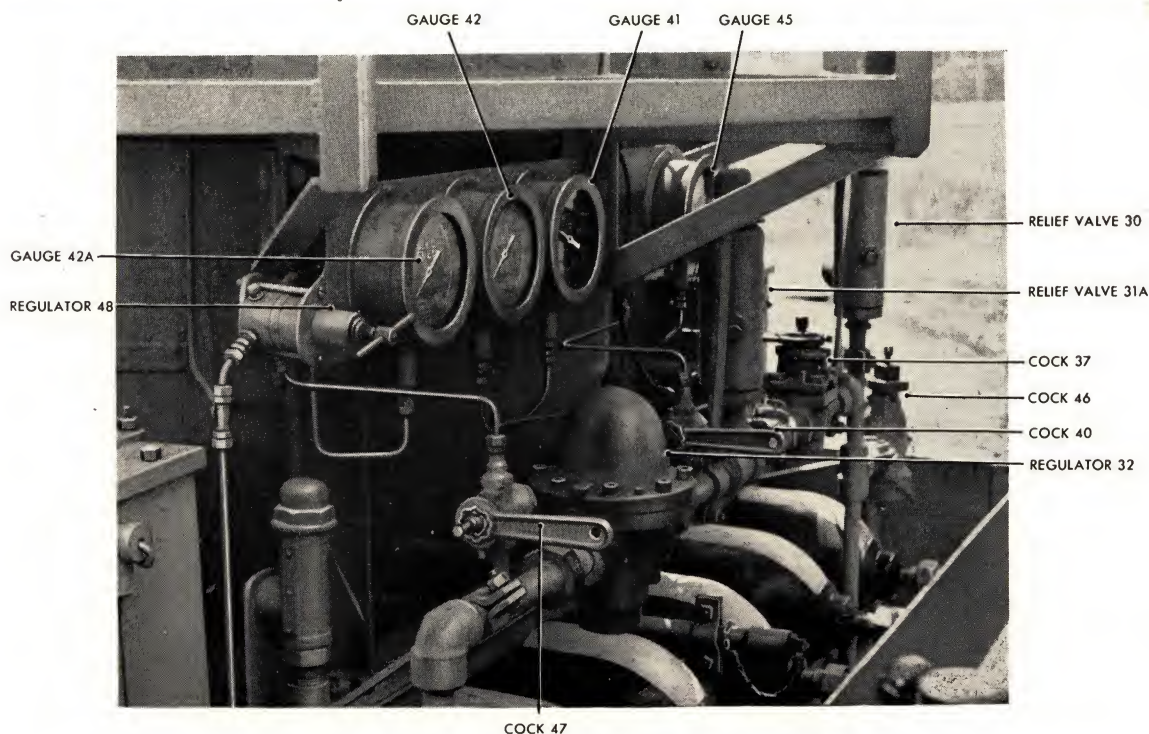


Figure 24.—View of Port Side of Main Air Line, Showing Cocks in Position for Air Servicing

DESCRIPTION

49. The compressor used for loading the air bottles of the Flame Thrower Mk 1 with 2,000-pound air is an Ingersoll Rand Type 40 Compressor designed to deliver 20 cubic feet of 3,000 p. s. i. air per hour. Details of the construction and operation of this compressor may be found in the Bulletin available with each compressor. Furnished with each servicing unit are four 20-foot lengths of high-pressure air hose type AN-H-6 or AN-H-6A to be used in the filling of the seven air bottles of the Flame Thrower Mk 1 unit. The four lengths of hose may be coupled together to provide 80 feet of hose in case remote filling is necessary. A special coupling is attached to one end of the 20-foot lengths, so that union may be made to the ordnance end fitting on the outlet end of the compressor.

CHARGING THE AIR BOTTLES

50. To charge the air bottles, turn off valve No. 36, shutting off air lines from the air bot-

tles to the unit. Remove the brass cap from the 3/4-inch air filling connection on valve No. 46. Then attach the air line from the compressor to the air filling connection. Open valve No. 46. This will allow air from the compressor to flow into the air bottles. Turn on the compressor and charge the bottles to 2000 p. s. i. This pressure will be shown on gauge No. 41. The safety valve, No. 30, is set to release the pressure at 2200 pounds.

Care should be taken to charge these bottles only to 2000 p. s. i. and not any higher. As soon as this pressure is reached, shut off the compressor. Then close valve No. 46, holding the air in the bottles. Bleed the compressor line at the compressor discharge, and then disconnect it from the air filling connection. Replace brass cap on the air filling connection of valve No. 46. Check to see that safeties (trigger locks) are set on both triggers of the gun unit. The air bottles will then be charged and procedure as indicated in Paragraph 41 may be undertaken in preparation for firing.

AIR SERVICING

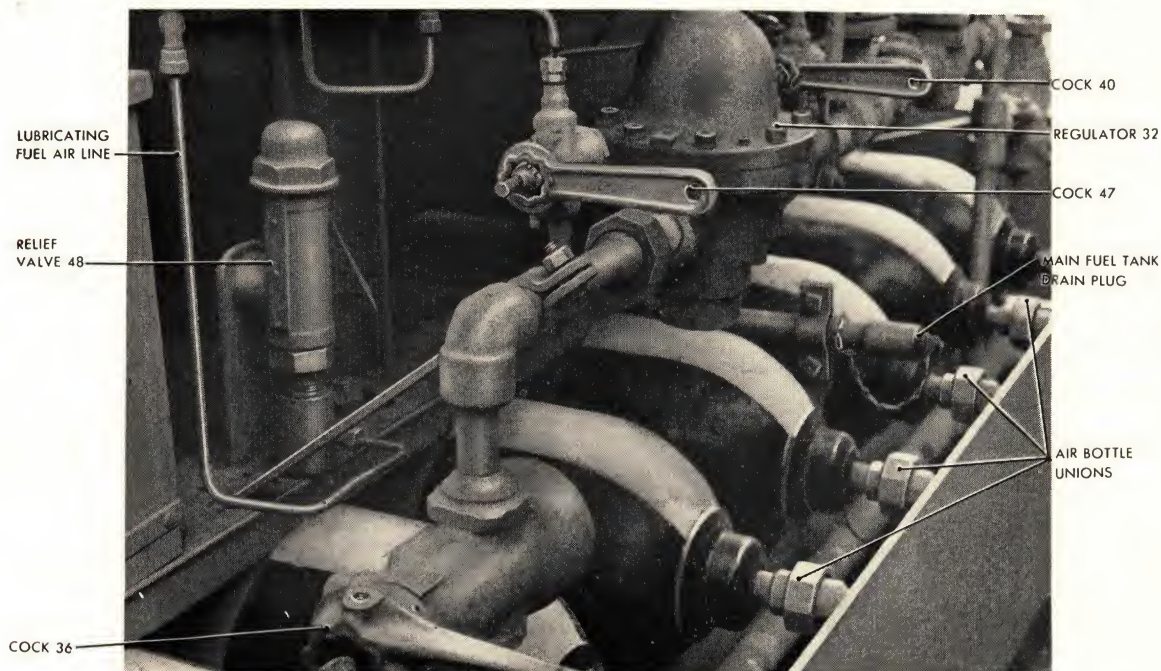


Figure 25.—Port Side View of Main Air Line, Showing Unions to Air Bottles and Other Items to be Tested for Leaks

TESTING AND MAINTENANCE

DESCRIPTION

51. Normal mechanical testing and maintenance of the unit include the examination of all piping joints, all cocks, all pressure regulators, all safety valves, the ignition system, the strainers, and all pressure gauges. The purpose of the examination is to see that the apparatus is operable and capable of continued service. Any defects disclosed in the examination should, if possible, be rectified. Serious defects may require replacement of the parts in question.

(a) The piping consists of pipe size tubing with American pipe threaded joints and small size ($\frac{1}{8}$ -inch and $\frac{1}{4}$ -inch O. D.) copper clad steel tubing, with flared or compression joints.

(b) The main air lines such as the air bottle manifold, distribution header, and lead line to the main fuel (gel) tank are of $\frac{3}{4}$ -inch and one-inch pipe size seam-

less steel tubing. All pipe up to the outlet of pressure regulator No. 32 is of extra heavy wall thickness. Beyond regulator No. 32 the pipe is of standard weight wall thickness. All pipe threaded joints except those of regulator No. 32 and the leads into the air bottles and to the relief valves No. 30 and No. 31A are brazed for security and tightness.

(c) The small air and gasoline lines for operational service are fitted with various types of compression joints which are revealed by examination. In general, leaks in these joints may be stopped by tightening the retainer nut; but if this fails, the entire length of the line between fittings must be replaced. The fittings may be salvaged by cutting the line and removing them. In replacing the line, be sure the proper fittings are used and threaded on the new line before flaring and expanding the ends of the line.

TESTING AND MAINTENANCE

O P 1139

(d) The brazed joints in the steel pipe line are made by brazing with bronze rod and borax flux, using an acetylene torch. The surface to be brazed should be carefully cleaned and free from dirt, oil and grease, and oxides.

TESTING

52. To test the joints, cocks, regulators, relief valves, and tubing, the fuel unit should be completely drained of fuel and the main fuel tank, atomizer gasoline tank No. 23, and secondary fuel tank No. 24, steamed out until there is no evidence of fuel remaining in these vessels. This will require about three hours. Admit low-pressure steam to the upper connections of the tanks and release it through the bottom connections. The plug in the drain line of the main fuel tank should be removed for this purpose and the 1/4-inch O. D. tube connections should be opened at the bottom of tanks No. 23 and No. 24.

While steaming the tanks, the pressure gauges No. 41, No. 42, No. 42A, No. 44, and No. 45 should be removed from their brackets and tested for accuracy by comparison with test gauges or by means of a "dead weight" tester. If necessary, the gauges should be adjusted and made to indicate accurately their normal operation pressures, which are as follows:

Pressure Gauge No.:

41	2000 p. s. i.
42	450 p. s. i.
42A	550 p. s. i.
44	65 p. s. i.
45	5 p. s. i.

After steaming and draining of all condensate, the plug, gauges, and joints should be replaced and air charged to the Flame Thrower Mk 1 as usual, after closing all cocks except No. 46. Pressure should be raised in the bottles to 2,200 p. s. i., at which point relief valve No. 30 should open. If it opens at a lower pressure, it must be adjusted for higher operation. If it fails to open at 2,200 p. s. i., it must be set for this pressure by removing the cap on the

top of the valve and loosening the lock nut on the treaded set screw.

Turning the set screw clockwise, looking down, raises the popping pressure. Counter-clockwise movement of the set screw lowers the popping pressure. After adjusting the set screw for the proper pressure, the lock nut should be tightened and the cap replaced. Pressure gauge No. 41 should be used to indicate the pressure in the bottles.

SPECIAL NOTE—Before testing beyond cock No. 36, regulating valve No. 32 should be examined. The threaded plug in the bottom of the body and the valve stem and lower spring should be removed.

Using the larger end of the socket wrench provided, the bushing and valve seat are then removed, after which the smaller end of the wrench is used to remove the valve stem guide and upper spring. The fine-mesh screen surrounding the valve seat should be examined for breakage and foreign matter. The screen should be replaced, if broken. If dirty, it should be washed in gasoline or naphtha and then dried before replacing. The valve and its seat should be inspected for scratches, and if necessary, reground or replaced. The springs should be replaced, if broken. The regulator should be reassembled and the bottom plug made tight, making sure the gasket inset in its face is in place and clean.

The high-pressure air bottle system having been tested and made tight, cock No. 36 should be slowly opened and air admitted to regulating valve No. 32, pressure gauge No. 42, and relief valve No. 31A. The pressure in this part of the system should be observed on pressure gauge No. 42 and regulator No. 32 adjusted to raise the pressure to 550 p. s. i. Relief valve No. 31A should pop at this pressure. If it does not, the valve should be adjusted as discussed in connection with relief valve No. 30. Leakage through cocks No. 47 and No. 40 may be ascertained by noting any increase in the indications of pressure gauges No. 42A, No. 45, and No. 44.

(a) All piping joints and cocks No. 46 and No. 36 should be tested for tightness

with the bottles charged with air. Soap solution should be applied with a brush to all joints and unions in the high-pressure system and to the air charging connection at the inlet to cock No. 46. The tightness of cock No. 36 can be determined by observation of pressure gauge No. 42. Any increase in the pressure shown by this gauge indicates leakage through cock No. 36.

(b) The formation of bubbles in the soap solution will indicate leakage that must be stopped. Brazed joints should be repaired by cleaning and rebrazing. The union nuts to the air bottles can be tightened with wrenches, using care to brace the piping on both sides of the union. The threaded connections in the necks of the air bottles are made up with thread sealing compound such as "Expando". Leaks at such points may be sealed by removing the nipple and re-making the joint with it, or a similar compound. To remove the nipple from an air bottle, the entire manifold must be removed from the bottles by opening all the unions. Steady pull should be applied by a pipe wrench to the nipple to be removed, and the neck of the air bottle should be struck sharply and repeatedly with a machinist's hammer. **Do not open any union or joint with air pressure on the system.** If necessary, vent the entire system down through the cock No. 46 after noting all points of leakage.

Leakage of cocks can be stopped by applying sealing and lubricating grease through the stem of the cock. To do this, the compression screw should be removed from the stem and a stick of Merco Nordstrom Lubricant No. 755, or similar compound, inserted in the hole and the screw replaced. Turning the screw forces the lubricant to the surfaces of the plug of the cock and seals any leakage. The force required to turn the screw indicates the condition of the cock. When this becomes high, the cock is sealed and any

further application of lubricant is to be avoided, as it forces the grease into the ports of the cock, where it will be picked up by the air and deposited on the filter screen of regulator No. 32. The cock can be lubricated under pressure, as the lubrication port in the stem of the cock is fitted with a ball check valve.

(d) All cocks should be sealed by application of lubricant No. 755, or similar compound, and a surplus of grease left in the reservoir of the stem for further application as required in service.

(e) Leakage through cock No. 37 can be tested by closing cock No. 36 and noting pressure gauge No. 42. If after a few minutes the pressure indication falls, cock No. 37 should be sealed.

(f) Open cock No. 36; raise pressure in line by adjustment of regulator No. 32 to 550 p. s. i. Pop relief valve No. 31A. Adjust if necessary.

(g) All joints and cocks in this part of the system having been made tight, regulator No. 32 should be readjusted to maintain a pressure of 450 p. s. i. as shown on No. 42. Instructions for adjusting regulator 32 will be found in the Grove Bulletin covering that unit. To test the operation of the main fuel tank cock No. 37 should be slowly opened after checking that cocks No. 38 and No. 39 are closed. 450-pound air pressure should then be applied to the main fuel tank and the body of Gun Mk 1. All joints, including the vertical and horizontal swivel joint and trunnion elbows on the gun, should be tested with soap solution. The tightness of cocks No. 38 and No. 39 should be tested by applying soap solution to their outlets. (The small vent hole in the dust cap on the outlet of cock No. 38 may be used for this purpose.) Should the joints of the gun show leakage, the linear rings of the assembly must be replaced by dismantling the joints and installing new rings. Pressure must be bled off the main fuel

TESTING AND MAINTENANCE

O P 1139

tank if this work is found necessary. The bolted joints of the gun and the cover flanges of the main fuel tank may be tightened with the bolts. Allen head screws are used on the gun and hexagon nuts and bolts are used in the blind cover flange of main fuel tank.

(h) To test the operating air system of the gun, cock No. 40 should be opened after checking that the auxiliary and atomizer fuel tank filling plugs are in place and cock No. 53 is closed. Pressure gauge No. 42A should indicate 450 p. s. i. Regulators No. 33 and No. 34 should be set as high as possible by turning their adjustment handles. All tubing joints, the outlet of cock No. 53, and escape ports or vents of the pilot and main control valves of the gun unit should be subjected to soap solution for indication of leaks. Leaks in the joints of the tubing may be stopped by tightening the nuts of the joints. Cock No. 53 may be made tight by application of grease No. 755, or equal. If the vents of the pilot or main control valve of gun show leakage, the air pressure must be removed and new linear rings installed in the valves.

(i) To test the atomizer system, regulators No. 33 and No. 34 should then be set for normal operating pressures. To do this, their adjusting screws should be turned counter-clockwise. The trigger of the ignition or left-hand grip should be held open while the regulators are being set. Regulator No. 33 for the atomizer fuel system should be adjusted to hold five p. s. i. as shown by gauge No. 45 and regulator No. 34 to hold 65 p. s. i. as shown by gauge No. 44 on the air to the atomizer.

(j) The lubricating or secondary fuel system should now be inspected and any defects disclosed rectified. The system begins at cock No. 47, which admits high-pressure air from the distribution manifold. Regulator No. 49 maintains a constant pressure of 550 p. s. i. on the lubri-

cating fuel system. This pressure may be observed on gauge No. 42A. Relief valve No. 48 is provided in the system to prevent the air pressure from exceeding 650 p. s. i. should regulator No. 49 stick open. To set relief valve No. 46, cock No. 47 should be opened and the adjusting screw of regulator No. 49 turned clockwise, while observing gauge No. 42A. At 650 p. s. i., relief valve No. 48 should pop. If it does not, it should be adjusted. The tubing joints, vent valve, and hose connections, as well as the lubricating tank, should be tested for tightness by means of soap solution. All leaks should be stopped. The system having been made tight and relief valve No. 48 set to pop at 650 p. s. i., the adjusting screw of regulator No. 49 should be turned counterclockwise until gauge No. 42A reads 550 p. s. i.

Cock No. 53 should be slowly opened and the pressure in the system reduced to 500 p. s. i. as shown by gauge No. 42A. After closing cock No. 53, the adjusting screw of regulator No. 49 should be used to set the regulator to hold 550 p. s. i. on the system.

(k) The ignition system inspection includes the two storage batteries, switch spark coils, spark plugs, grounded electrodes, primary and secondary wiring, and all electrical connections. The first item to check is the condition of the storage batteries as indicated by the specific gravity of the electrolyte. A battery-testing hydrometer should be used for this purpose and the electrolyte of each cell of the batteries sampled. If the specific gravity of the electrolyte is below 1.150, the battery should be charged and the specific gravity increased to 1.210 to 1.220. Distilled water should be added to bring the level of the electrolyte in each cell 1/2 inch above the plates. During charging, the filling caps should be in place but not tightened down.

All terminal connections in the entire electrical system should be carefully

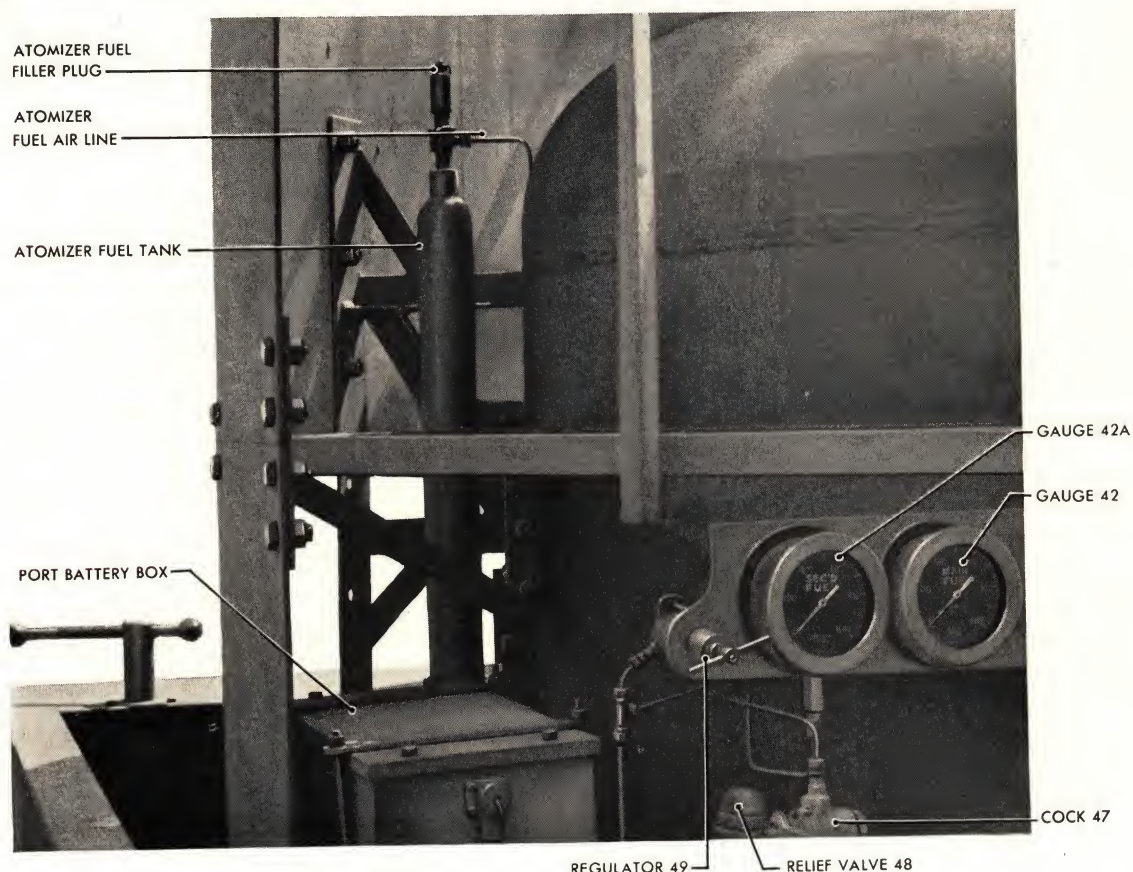


Figure 26.—Main Fuel Tank, Port Side, Showing Atomizer Filler Plug

examined for cleanliness and tightness. These connections include those of the batteries, the switch in the ignition trigger grip, the spark coils, and the spark plug terminal. The spark gap of each plug located in the forward compartment of the ignition chimney should be checked. The gap should be 1/16 inch. Any adjustment required to obtain this gap should be made in the ground electrode, which is threaded through the wall of the chimney opposite each spark plug. The fittings through which the cables pass to the battery and spark coil boxes, as well as the tightness of the covers for these boxes, should be examined. The fittings must be made tight by turning the nut of each fitting. The box covers should be weather-proof and may require

new gaskets and tightening of the holding bolts or screws. To test the spark, the air supply to the atomizer system should be cut off by closing cock No. 40. Residual pressure on the atomizer fuel tank should be bled off by removing the filling plug on tank No. 23; see Fig. 26. Then the ignition trigger of the gun should be operated.

After several operations to insure the absence of a combustible mixture in the chimney, direct visual observation should be made to ascertain if both plugs are sparking. If only one plug sparks, the ignition system from the trigger switch to the plug in question must be carefully traced. The cover over the rear compartment of the chimney should be removed and the connections to the plugs

TESTING AND MAINTENANCE

O P 1139

opened up by pulling the cables away from the plugs. The rubber boots over the terminal of the cables should be removed or slipped back to expose the clips in the ends of the cables. The condition of the insulation of the cables should be carefully examined. If necessary, it should be replaced from the spark plug to the spark coil No. 4. Replacement cable should be seven-mm. cable Spec. AN-JC-56. The terminals from each end of the replaced cable should be removed and firmly secured to the new cable lead. Replacement of the rubber boot and the woven asbestos sleeve at the plug end of the cable may be advisable. A questionable spark plug should be removed and replaced by an Edison-Splitdorf Special Igniter Type I-9A plug.

The gap of $\frac{1}{16}$ -inch between the ground and the plug electrodes should be checked. If either plug does not spark, the cable leads to each plug should be interchanged at the spark plug terminals. If this change results in causing the previously operating spark plug to fail to function, the trouble may be in one of the spark coils No. 7. The high and low tension connections to the coil in question should be inspected, as well as the connection at the switch in the pistol grip. If the connections are clean and tight and no spark results, the vibrator of the spark coil No. 7 should be replaced from spare stock.

Failure to obtain a spark thereafter

requires that the entire spark coil assembly No. 7 be replaced. The holding clamp of the chimney to the nozzle has been relieved on its sides to provide clearance for the high-tension system. See that the clamp is applied so that this clearance is effective. **NOTE: Do not operate the switch trigger while handling any part of the secondary or high tension system unless protected by rubber gloves suitable for high tension insulation.**

(l) All armor bolts should be checked for tightness and tightened if necessary.

(m) Descriptions of the adjustment and maintenance of special parts such as regulators should be obtained from the instructions pamphlets furnished by the various manufacturers. Some of these publications are:

1. Welding—cutting apparatus—Pressure Regulators and Safety Valves—Trex Engineering Supply Company, 611 McCarter Highway, Newark, New Jersey.

2. Grove Powreactor Dome Regulators—Bulletin No. 123A with Instruction Sheet Bulletin No. 114. Grove Regulator Company, 1190 67th Street, Oakland, California.

3. Quimby Screw Pumps—Gear-in-Head Type—Bulletin No. S-203A and also Quimby Pumps—Instruction Manual, Quimby Pump Company, 340 Thomas Street, Newark, New Jersey.

FLAME THROWERS

O P 1139

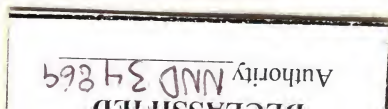
53: FLAME THROWER MK 1—GUN UNIT LIST OF DRAWINGS

BuOrd Drawing No.	Title	Standard Oil Dev. Co. No.
421371	Main Valve Disc Col- lar	D149-77
421372	Main Valve Disc	D149-78
421373	Main Valve Seat	D149-80A
421374	Control Valve Spring Housing	D149-82
421375	Control Valve Spring	D149-86
421376	Pilot Valve Cover	D149-88
421377	Pilot Valve Piston	D149-91
421378	Pilot and Atomizer Valve Spring	D149-92
421379	Trigger Lock Pin	D149-98
421380	Trigger Lock Spring	D149-99
421381	Trigger Lock Collar	D149-100
421382	Control Bracket Post (R. H.)	D149-107
421383	Forward Valve Body	D149-108
421384	Atomizer Spring Housing	D149-109
421385	Atomizer Piston	D149-110
421386	Atomizer Valve Stem	D149-111
421387	Main Valve Disc Washer	D149-112
421388	Main Spring Housing Nut	D149-115
421389	Main Spring Seat	D149-116
421390	Control Bracket (Post)	D149-125
421391	Tube Block	D149-126
421392	Gaskets	D149-127
434065	Nozzle	B149-66E
434066	After Gun Body	B149-71
434067	Control Valve Body Complete	B149-81
434068	Pilot Valve and After Valve Body Com- plete	B149-87
434069	Yoke Connector Complete	B149-104
434070	Control Bracket (Dual)	B149-105
434071	Main Valve Spring Housing	B149-113
434072	Valve Bracket Dual	B149-117

BuOrd Drawing No.	Title	M. W. Kellogg Co. No.
437856	Forward Gun Body	A149-67B
437857	Yoke	A149-102-1
437858	Dimensional Outline	A149-120
437859	Sectional Elevation	A149-122
451605	Trunnion Elbow	C149-68-2
451606	Trunnion Elbow	C149-68-2A
451607	Trunnion Elbow Collar	C149-70
451608	Main Piston Spring	C149-75
451609	Main Valve Piston	C149-76
451610	Control Valve Piston Bonnet	C149-83
451611	Control Valve Piston	C149-85
451612	Trigger	C149-101
451613	Yoke Collar	C149-103

54: FLAME THROWER MK 1—FUEL UNIT LIST OF DRAWINGS

BuOrd Drawing No.	Title	Standard Oil Dev. Co. No.
434073	Ignition Chimney Cover	11595-B
437841	Lubricator and Atomizer Fuel Tanks (Details)	15407-A
437842	Main Fuel Tank (Details)	15408-A
437843	Gunner's Platform	15409-A
437844	Main Fuel Tanks and Air Bottle Supports (De- tails)	15410-A
437845	Protecting Armor For Main Fuel Tank, Air Bottles, and Gunner (Details)	15411-A
437846	Piping Arrangement— Fuel Units, Controls, and Primary Electrical Circuit	15412-A
437847	Flow Diagram	15413-A
437848	General Arrangement of Fuel Unit and Gun	15414-A
437849	Details of Cleats and Brackets for Armor Plate	15415-A
437850	Study of Arrangement of Gunner's Armor	15416-A
437851	Light Ignition Chimney Assembly (1/8 in. Thick)	15417-A



FLAME THROWER MK 2 AND MOD

O P 1139

54. FLAME THROWER MK 1—FUEL UNIT LIST OF DRAWINGS

BuOrd Drawing No.	Title	M. W. Kellogg Co. No.
437852	Arrangement of Air, Fuel and Electrical Lines for Gun Unit	15418-A
437853	Heavy Ignition Chimney Assembly (½ in. Thick)	15419-A
437854	Main Fuel Servicing Unit	15420-A
437855	Bracket for Support of Rheostat and Switch for Main Fuel Servicing Pump	15421-A

DESCRIPTION

55. Flame Thrower Mk 2 is the Bureau of Ordnance designation for the Canadian Ronson F. U. L. Flame Thrower Mk IV. It is a carbon dioxide operating unit and requires a heat exchanger for efficient operation in its original form. This unit, converted to air pressure operation, has been designated by the Bureau of Ordnance as Flame Thrower Mk 2 Mod 1.

In the Canadian Ronson F. U. L. Mk IV Instruction Book and Parts List furnished with each unit, a complete description of the equipment is given. This booklet, designated as part number 979516, and also the supplementary booklets entitled Canadian Army Modification and Service Information Bulletins, should be consulted before assembly and use of this equipment is attempted. These bulletins bear the designation Ronson

Mod 1, 27-4-43; Mod 2, 27-4-43; Mod 3, 27-4-43; Mod 4, 27-4-43; Mod 5, 27-4-43; Mod 6, 15-5-43; Mod 7, 15-5-43; Mod 8, 6-8-43; and S.I.-1, 27-4-43; S.I.-2, 30-4-43; S.I.-3, 15-5-43; S.I.-4, 10-9-43; and Mod 9, 1-10-43.

(a) Because of the adaptability of this unit to mounting on any universal carrier, it was considered expedient to test its usefulness when mounted in landing craft. It has the disadvantage that it may be fired only in bursts, since the petrol or gasoline which is supplied for ignition, is forced to the atomizer by means of a pump in the amount of approximately 15 cc per stroke of the pump. The range of this unit is of the order of 50 yards (effective-center of deposit), and the expellant pressure or operating pressure is of the order of 160 p. s. i.

(b) Since it may be required to fire the unit under certain tactical conditions in continuous bursts of relatively long duration, it was decided to modify the unit for air operation. As a supplementary consideration, an attempt to improve the range characteristics by increasing operating pressures was also made. It must be pointed out, however, that the original design called for operation at the pressure stated above, and hence the operational characteristics of the various parts still employed may be greatly impaired. A complete description of the conversion is given in paragraph 56 of this pamphlet.

CONVERSION OF THE CANADIAN RONSON F. U. L. UNIT MARK IV FROM CARBON DIOXIDE TO AIR PRESSURE OPERATION

56. The purpose of this conversion is to (a) provide for continuous firing, if desired, until fuel tanks are exhausted, (b) provide a steady and somewhat increased pressure during operation so that effective range may be improved, and (c) eliminate certain non-essential parts, such as the heat exchanger, which tend to complicate the mechanism and to restrict its use. The unit as received is intended for operation by carbon dioxide pressure. Refer to the diagrammatic lay-out on Page 2 of the Instruction Book and Parts List. The unit as received is intended to function as follows: when the trigger is actuated, the trigger valve opens, allowing pressure to flow to the actuating cylinder. When the actuating cylinder throws the rocking lever:

(a) The petrol pump makes one stroke, throwing a measured charge of gasoline through the petrol jets, where it is ignited by an electric spark which was initiated by the closing of a switch mounted on the trigger valve and actuated by the trigger.

(b) The carbon dioxide valve in the control box is opened, allowing carbon dioxide to flow from its high-pressure container to the heat exchanger and from thence to the fuel tanks, where it tends to force the fuel to its nozzle.

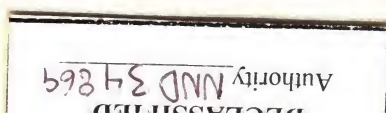
(c) The main fuel valve is opened, allowing the fuel to flow from its tanks to the nozzle, where it is ignited by the flaming gasoline. When the unit is operated by carbon dioxide, its range is less than considered desirable, and it can only be operated in short bursts. The purpose of modifying the unit to operate on high-pressure air is to increase the range and to permit the flame to be continuous as long as there is fuel in the tanks.

The unit as shipped by the manufacturer and intended for carbon dioxide operation will be received knocked-down. It is to be as-

sembled in accordance with the manufacturer's instructions, a copy of which will be received with each unit, except by the modifications which are described herein. **CAUTION:** The diagrammatic sketch of the conversion (BuOrd dwg. 423414) listing the new parts necessary and other important parts of the apparatus should be consulted in making the conversion. It should be noted in making the conversion that The Ronson F. U. L. Unit Mk IV was designed to operate at 160 p. s. i., and hence the parts of the equipment to be used should be tested before use, at or above the operating pressure desired. The unit was originally intended for mounting upon an automotive vehicle. As assembled for U. S. Naval use it should be mounted on a skid or otherwise, according to the purposes intended for the particular unit.

Certain parts of the unit as received from the manufacturer will not be used. These parts are the carbon dioxide container with its valve, the petrol pump with its attachments, the float chamber, the heat exchanger, the present pressure gauge (having a scale which reads only 200 p.s.i.) and certain other pipes and fittings. To facilitate conversion, the unit should be temporarily assembled as if intended for carbon dioxide operation. After assembly has been completed, proceed as follows:

(d) Gun assembly (See Instruction Booklet, Page 27). Remove gun shroud, the metal tube which encloses the nozzle and the petrol jets. Disconnect pipe assembly (Part No. 979267, See Instruction Booklet Page 27) and remove ball (Part No. 979054) and spring (Part No. 979055) from petrol jet housing (Part No. 979052). Replace spring with new spring provided (new Parts List No. 22) and using same ball see that it does not drop beneath spring while ball seating valve (Part No. 979053) is being screwed back



FLAME THROWER MK 2 AND MOD

O P 1139

into petrol jet housing (Part No. 979052). Reassemble pipe assembly. Replace gun shroud.

(e) Control box assembly (See Instruction Book drawing on Pages 30 and 31). Remove the petrol pump (drawing Part 38), float chamber (drawing Part 44), and hook or priming handle (drawing Part 36) but do not remove the manual or priming lever (drawing Part 85). Discard the removed parts. Remove tubing (drawing Part 37) that connected the petrol pump to the petrol pipe assembly (drawing Part 13). Remove tubing (drawing No. 58, Page 31, Parts List No. 979277) that connected carbon dioxide valve to pipe No. 979270 which ran to heat exchanger. (This part is shown on Page 23.) Now connect these tubes (drawings Nos. 37 and 58) together. One end is then connected to the carbon dioxide valve and the other to the tube (Part No. 979263; see Page 24) leading to the petrol jets in the gun. The control box should be securely mounted so that the line (drawing Part 5) connecting the main fuel valve (Part No. 979102, Page 24) and the control or rocking lever (drawing Part 84) can function freely with the fuel valve lever (Part No. 979103, Page 25). When the fuel valve lever is vertical, the valve is closed. Adjust the link (drawing Part 5) so that the fuel valve is completely closed. There is a slot at the end of the line (where it is connected to the rocking lever). Plug this slot so that there is no play in this connection. This may be done by placing two ¼-inch bolts through the slot, fastening them securely.

(f) In the general piping and positioning of equipment attach pipe (Part No. 979294; see pages 22, 23, and 24) to the fuel tank and connect the spill box Part No. 979237 to the other end. Connect pipe (Part No. 979292) to the spill box. Secure the pop valve (Part No. 24, new Parts List) to the tee (Part No.

979291) nearest the spill box and set the pop valve to release at 350 pounds pressure. Connect the tube (Part No. 979298, Pages 24 and 28) to the trigger or operating valve (drawing Part 18, Page 30) and to the second tee (Part No. 979291, Page 24) on the pipe (Part No. 979292, Page 24). Position air bottle (new Parts List, Item 2). Tap and plug vent hole in outlet head. Remove bleeder valve from air bottle and thread a short length of pipe and screw into bleeder valve seat. Then attach gauge (new Parts List, Item 1) to this pipe. Position adapter (new Parts List, Item 3) and attach high pressure valve (new Parts List, Item 4) to pipe from adapter (see schematic conversion drawing BuOrd No. 423414). Air bottle is now ready to be charged. Set Grove reducing valve (new Parts List, Item 7) for 250 p. s. i. and screw into Grove reducer. Secure regulator to ½"x ½"x ½"x ½" cross fitting (new Parts List, Item 10) by means of adapter (new Parts List, Item 8). Secure gauge (new Parts List, Item 14) and pipe leading from main fuel tank to ½"x ½"x ½"x ½" p. s. i. cross fitting (new Parts List, Item 10) and connect ½-inch pipe tee (new Parts List, Item 12) to the cross with a short length of pipe. Mount vent valve (new Parts List, Item 13) and screw adapter (new Parts List, Item 15) into ½-inch tee (new Parts List, Item 12) and connect tubing (new Parts List, Item 16) to the adapter. Connect the other end of this tubing to the ¾-inch cross fitting (new Parts List, Item 17) on the 200-cubic-inch ignition gasoline bottle (new Parts List, Item 19) and plug one of the cross outlets. Cut a length of ¾-inch tubing about 14 inches long. Flange the top and insert into the bottle. This 200-cubic-inch bottle should be fixed in a vertical position.

Now air will force the gasoline in the bottle out through the tube to the carbon dioxide valve (drawing No. 69, Page 30, Part G 979162) which is connected by

means of tube (new Parts List, Item 20) to the 200-cubic-inch gasoline bottle. The adapter (new Parts List, Item 21) is used for this connection. Replace rubber sealing washer (Part No. 979560, Page 35) with neoprene washer (new Parts List, Item 23). Install and connect battery as shown on Page 2 of Ronson Instruction Manual; and the unit is assembled.

(g) In preparation for firing, test the ignition spark before any fuel is placed in the tank. Fill the 200-cubic-inch bottle (new Parts List, Item 19) two-thirds full of gasoline. Mix Napalm and gasoline by placing from five to ten gallons of gasoline in a stone or non-galvanized drum and pouring in the proper amount of Napalm (five pounds, four ounces per 20 gallons of gasoline). The mixture should be stirred slowly and steadily until the Napalm becomes "solvated" or completely suspended in the gasoline. The mixture now becomes "soupy". When it has been determined that the Napalm does not settle out when stirring ceases, the mixture should be poured into the fuel tanks of the flame thrower, where it should "set" for at least 2 hours prior to use. A longer setting time, i.e., up to 24 hours, is desirable but not essential.

Extreme care should be taken that no water is present in the mixing container and the fuel tanks, since the Napalm itself is very hygroscopic and improper gelling will result from the presence of moisture. The Napalm should also be transferred to the gasoline as rapidly as possible, in order to eliminate the possibility of moisture absorption from the air. Properly mixed, the fuel should be stable in storage indefinitely, provided it is kept in air-tight containers. The following procedure must be followed to check the ignition system and prepare the unit for firing:

(1) Close main nozzle control on gun. This prevents opening of nozzle.

(2) Open valve on air bottle, thus allowing pressure to build up in the system.

(3) Twist the trigger. With the main nozzle control closed, only the ignition system will operate.

(4) The trigger is released and the main nozzle control is opened completely. The weapon is now ready for firing.

When the trigger is twisted for firing the gun, the following actions take place:

(5) The ignition switch is closed, connecting the battery to the spark coil and causing a spark across the gap at the petrol jet.

(6) An instant later, the trigger valve is opened, allowing pressure to build up in the actuating cylinder and causing it to function.

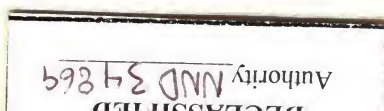
(7) The piston in the cylinder moves and forces the rocker lever to pivot on its fulcrum.

(8) The adjusting cam on the rocker arm causes the carbon dioxide valve (now used for controlling the gasoline supply for the ignition system) to open. Gasoline under pressure then passes to the petrol jets in the gun.

(9) Then, the link connecting the main fuel valve and the end of the rocker arm moves up with the rocker arm, opening the fuel valve.

(10) The fuel, under pressure, moves through the main fuel line out the nozzle, where it is ignited as it passes through the burning gasoline ignition flame.

(11) The main nozzle control is used only in testing the ignition flame or in making adjustments if the main fuel valve does not work properly.



FLAME THROWER MK 2 AND MOD

O P 1139

NEW PARTS LIST

57. The new parts needed for conversion of Canadian Ronson Flame Thrower Mk IV to Flame Thrower Mk 2 Mod 1 are as follows:

- (1) High-pressure gauge 0-5000 p. s. i.
- (2) Air bottle 3 cubic feet tested 5000 p. s. i.
- (3) Adapter 1¼ inches 12 thread to 1½ inches 14 thread 60° seat
- (4) High-pressure valve
- (5) High-pressure tubing, tested 5000 p. s. i.
- (6) Same as three
- (7) Grove high-pressure regulator
- (8) Adapter one-inch bushing to ½-inch I. P. S.
- (9) ½-inch pipe union
- (10) ½-inch pipe, extra strong
- (11) ½-inch pipe, one end threaded for ½-inch British pipe; other end U. S. Standard ½-inch I. P. S.
- (12) ½-inch Tee I. P. S.
- (13) ½-inch high-pressure valve
- (14) High-pressure gauge 0-500 p. s. i.
- (15) Adapter ½-inch pipe to ¾-inch 20-thread (radius seat)
- (16) High-pressure tubing
- (17) Extra strong fitting male ¾-inch 20-thread
- (18) ¼-inch copper tube 14 inches long flanged top

- (19) 200 cubic inch bottle
- (20) High-pressure tubing
- (21) Adapter same as 15
- (22) Spring to replace spring (drawing No. 979055) on Page 27 of Instruction Booklet
- (23) Neoprene washer to replace rubber washer (drawing No. 979560) on Page 35 of Instruction Booklet
- (24) Pop valve

Particular note should be made that this unit uses a thickened fuel of a considerably different consistency than is recommended for the U. S. Navy Flame Thrower Mk 1. It is entirely possible that experimentation may prove that it is possible to use the same thickened fuel in both types of equipment. Until this is definitely proved, however, only the thickened gasoline recommended for each type of flame thrower should be used. It is also realized that, because of the highly experimental nature of this type of equipment, many improvements will suggest themselves as a result of testing and service use. In order for these suggestions to achieve the most possible good, it is desired that they—as well as any criticisms—be forwarded to the Bureau of Ordnance as soon as is practicable, so that the necessary steps may be taken to insure for all users the most efficient operation possible.